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Vol. VI. NEW YORK, NOVEMBER 21, 1885. No. 21.

THE value of the electric light, commercially, is shown in an incidental way in the estimates of the traffic through the proposed Nicaraugua Canal. The figures are largely based on the theory that the canal shall be illuminated by electricity so that night need not cause the least stoppage or delay of traffic.

IN spite of the adverse criticism brought to bear on the Erie Telephone Company, President Bennett makes the statement that though the figures of instruments in use are smaller, the company now has more paying subscribers than ever before; the fact being that the "free list has been suspended," and that unremunerative exchanges are shut down.

DR. NORVIN GREEN and Mr. Bates may be quite sincere in their protestations that no cutting of rates competitively is being made or is in contemplation by their respective companies. But the reports that there is cutting do not cease, and it would appear that as before, to use a sporting phrase, the Mutual Union is employed to "make the running." Behind the Bulgarian Mutual Union looms up the Russian Western Union.

IT is said to be likely that a meeting of the American Institute of Electrical Engineers will be held early in December, when one or two papers will be read. We are glad to hear this, and trust that the members will take sufficient interest in the matter to attend and take part in the discussions. The Institute can be made of very great service to electrical science and application in this country, and deserves all the support that can be given it.

AT last M. Deprez has succeeded in demonstrating that he could transmit, for a distance of thirty-five miles, a comparatively large amount of power. In one of his experiments, which we hope to give in detail in our next issue, M. Deprez succeeded in obtaining 40 horse-power from his receiver, with an efficiency of 50 per cent. This is a most encouraging result, but it has been obtained in a manner which we shall have occasion to refer to in criticism later on.

THE prevailing impression among foreigners that "wire-tapping" is a peculiarly American institution is now roughly disabused by a recent discovery made in England. There, two men were found in a room above a "club" in which betting was going on. While not actually tapping the wire, they grounded it so as to delay the message long enough for them to obtain the desired information elsewhere, and to bet accordingly. This is rather a refinement on the American method, but unfortunately for them, they were soon detected and punished.

WE have followed up again this week in our columns the hearing at Washington before Secretary Lamar on the petitions to have the United States bring a suit to upset the Bell patent; and it will be seen that there is really little important that is new or new that is important. The most weighty affidavit is that of Prof. Elisha Gray, who regards himself as an illused and deceived man. The case here, as in so many other parts, rests largely on the credibility of the story told. Professor Gray's version of his experience has been received with respectful attention by electricians generally, but has the disadvantage of coming late in the day.

THERE has for some time been very little activity manifested here in the domain of the storage battery, and this seems all the more strange in view of the progress which had been predicted to take place. It would appear, however, that this is only the calm preceding the tempest, for we understand that a powerful syndicate has taken up the subject, and judging from the stamp of the men included in it, great things are in store for the "storer." It would be premature to announce anything definite, but we are informed that active preparations are now being made for a thorough working of the accumulator field and by men who have made their mark in other electrical enterprises.

THE storage battery in the past has perhaps suffered most at the hands of its friends in predicting too much and too early. As a consequence, the true performance of the cell, being behind the predictions, has caused it to be looked upon with distrust. This, however, is unmerited. Considered independently, the performance of the storage battery to-day is a good one, and future developments will all be in the line of improvement. But we would again regret the weakness of some interested gentlemen who make statements regarding the application and power of storage batteries knowing them to be untrue. It is such men who undermine public confidence, and one failure due to them is scarcely remedied by a dozen successes of more conservative workers.

IT seems strange that the construction of a standard electric lamp should have been so long delayed; but now that we have one it would be well to point out that for prolonged accuracy it must, like other secondary standards be compared with the original from time to time. The Edison instrument described in another column is evidently accurate only as long as the resistance of the lamp remains constant. Any change in this respect will cause change in illuminating power. Hence where accuracy is required the lamp ought to be compared with a standard candle occasionally. The use of the electric lamp, however, is so convenient that it will easily supersede other methods in which constant corrections are required.

THE first of our series of articles on electric meters invented in this country points to the rather curious feature that such meters have as yet come into but comparatively little use. The reason evidently must be sought in the fact that central stations are as yet comparatively small in number, and it is only in connection with such that they can find extensive employment. Many of the most eminent electricians have applied themselves to their construction and the results show a variety of forms. This is to be expected, for there is scarcely a phenomenon exhibited by the action of the electric current which cannot in some way be called into play for the desired purpose. In this respect the electric meter resembles the galvanometer, the last of whose forms has by no means been reached, as our columns frequently bear witness.

THE electric lighting of trains is a subject which may well absorb the attention of electricians. When the storage battery was first prominently brought out some time ago, it was thought that its application for this purpose would quickly become widespread, but like many promises made for the storage battery at that time, subsequent events proved them premature. A separate engine and dynamo on board a train removes the inconvenience which the batteries charged from stationary engines present, but economical reasons seem to preclude this method if we may judge from its non-application. The utilization of the power to be derived from the car axles seems to present an easy solution of the problem, and in connection with the storage battery appears also to afford a number of advantages. It does away with charging by stationary engines and with the engine on the train. With the steady improvement taking place both in capacity and durability of the storage battery, the time cannot be far removed when this will prove perhaps the most economical as well as desirable method of train illumination.

AS the first public test of dynamos undertaken in this country, the trials recently terminated by the Franklin Institute must attract attention, not only on account of the excellent results obtained with the machines, but also on account of the elaborate methods employed in insuring their correctness. Guided by earlier European examples, the Franklin Institute committee were enabled to apply the most approved methods, and nothing seems to have been left unconsidered. Our condensed report in another column, in supplementing our article of last week, will convey a good idea of the precautions taken to insure absolute accuracy, and will, no doubt, prove of interest from a practical as well as from a scientific standpoint. It is rarely that dynamo makers have the facilities for undertaking such trials, and their statements are generally taken with reserve by the public. It is therefore doubly valuable to be able to point to an excellent report made by disinterested parties, and the competing companies have reason for congratulation on this accession to their "list of superiorities."

AT this time of writing, the annual meeting of the Telegraphers' Mutual Benefit Association has not been held, the day fixed being the 19th inst. But in advance of the meeting, we are enabled through the kindness of the officers to publish a report, in brief, condensed form, of the work accomplished during 1884-5. It will be seen that the Association is in excellent financial shape, and that its membership is growing; and we have no doubt that the report will be accepted with many feelings of pleasure by all whom it concerns. It is often said that telegraphers are a thriftless body of men, and it is too true that many telegraphers have not been sufficiently regardful of the future. On the other hand, the telegrapher can say that his limited earnings have afforded him neither the opportunity nor the wherewithal to save; and he can also call attention with proper pride to the fact that here is a mutual help association, one of the oldest of the kind in the country, founded by himself and his fellows, now prospering in a notable manner, and displaying a roll of nearly three thousand members, many of whom, struggling along nobly, have said resolutely that, come what may, their families shall have some provision in the last, dread emergency. The Association has our heartiest congratulations as it closes another successful year, and our warmest wishes for its long-continued prosperity.

THE applications of electricity in warfare which Lieut. Bradley A. Fiske describes in such an interesting manner in the lecture, the report of which begins in this issue, brings out the fact that the electrician is a most necessary adjunct to the personnel of a war ship as well as of a land fortification. He proves in this first part and in the following ones that the safety of a city, and even of a country, may depend upon the proper application of defences under electrical control. A survey of Lieutenant Fiske's lecture shows that for warlike purposes electricity is pressed into almost every conceivable use, even to the most refined and such as are rarely necessary outside the laboratory. We are not fully informed as to the extent of the study of electricity at the Government Military and Naval Academies, but it would appear to be obvious that a thorough training in this respect would be quite essential to the equipment of the cadets. There are as yet few, if any, of our war ships or forts fully equipped from the electrical standpoint, and it would seem that a Bureau of Electrical Engineering, similar to that of Steam Engineering, in the Navy Department, would have plenty of opportunity for good work, and that competent men would not be found wanting to take charge of it. Recent wars have shown that battles are now won by brains rather than by big battalions, and the more brains that can be brought into our war establishment the better.

History of the Electric Meter in America; Its Development and Various Forms.

BY F. B. BROCK.

The electric meter is a very recent invention in America. It had no practical existence in electrical progress until after the advent of electric lighting as a legitimate commercial business. Before the date of the electrical illumination of our streets, the electric meter had no practical application, at least on any such scale as to warrant its manufacture by makers of electrical goods.

The true electric-meter has its points of novelty which distinguish it from its sister inventions, the indicator telegraph, the galvanometer and the electroscope, although it involves, in some of its forms, the same principles of construction.

The first patent issued by the United States for an electric meter was granted as late as 1872, to George Little. It is constructed upon the principle of an indicator telegraph, but the means for determining or registering the periods of electrical excitation or the electromotive force of the current are not satisfactory. It had a more specific use in the detection of errors of insulation or defects in the current, which are apparent from an inspection of the instrument in the patent drawings.

Little's invention comprised a steel needle suspended within a glass tube filled with alcohol. The glass tube is contiguous to a helix which is movable, so as to be adjusted nearer to or further from the needle. When the current is weak the helix is moved nearer to the tube and needle, but when the current is stronger it is moved further off. The helix, being influenced by the pulsations of the current, acts upon the needle, and, by its movement, indicates that the circuit is in working condition; while, if the needle is not moved, or only slightly affected, the defective condition of the line is instantly shown. It differs in few respects from the ordinary galvanometer principle.

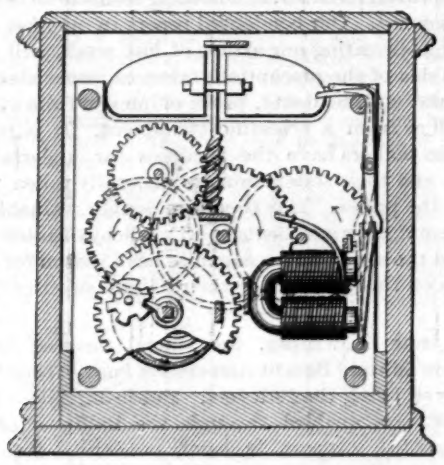


FIG. 1.

In the same year, Samuel Gardiner, Jr., one of the inventors of the Gardiner & Blossum incandescent lamp of 1858 (of which we gave an account in THE ELECTRICAL WORLD of Oct. 3), constructed an electric meter, of which we give two views in Figs. 1 and 2—a vertical section and a side elevation.

We believe this to be the first example of a true electric meter patented in this country. It does not accomplish, however, all the results which the improved meter of to-day does. There is no registry of the intensity or electromotive force. It is simply a time-check, although the register dial-indicator would seem to mark the passage of the current.

From an inspection of the illustrations it will be seen that an electro-magnet is secured within the meter, and electrically connected with the line, the current of which it is desired to measure. An armature, having a hooked lever projecting therefrom by a swivel joint, is also pivoted to the meter casing.

When the current passes through the meter, it energizes the electro-magnet, and causes the armature to approach and move the hooked lever, which latter releases the "fly" of the clockwork, and allows the train of gears to register approximately the amount of electricity which passes by way of the magnet to the point where it is used.

The construction of the clockwork is such that, when the mainspring is uncoiled, a pin on one of the wheels comes in contact with a switch electrode, and severs the electric connection. This has the effect of preventing any further use of the current until the registering device is removed. Thus it is quite impossible for a person to have the use of the electricity, unless the registering device is kept wound up.

Gardiner had in view the same purposes for which the meter of to-day is designed. He says his invention is "a device for registering the amount of electricity used or consumed in dwellings or places of business."

In the early development of the electric meter, the use of a spring-driven train of registering gears is an important element. The following claim of the Gardiner patent, in this connection, has an important bearing upon the growth of the art. It is as follows:

"The combination and arrangement of an electro-magnet and its armature, with the releasing device of a clock mechanism for indicating upon a dial the time during which an electrical current is in action."

It was not until six years later, or in 1878, that the next patent was issued for an electric meter, and then Mr. W. E. Sawyer, of Sawyer & Man, was the patentee.

Mr. Sawyer was evidently not aware that an electric meter had ever before been conceived of at the time he made his application, for he stated then that "such a device being entirely new in the arts, I intend to claim it broadly, not only as a meter or register, but in combination with an electric light; and I do not confine myself to any particular device or arrangement of parts."

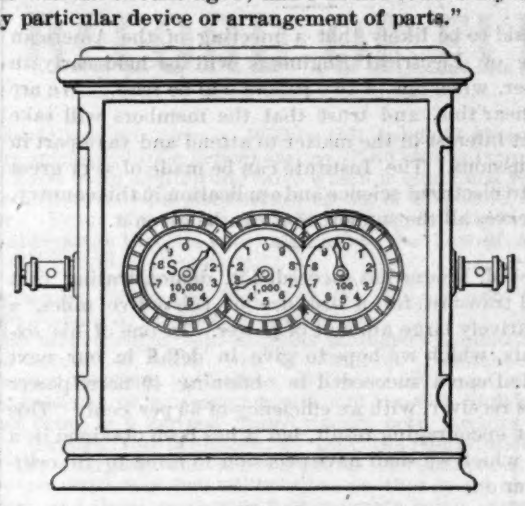


FIG. 2.

The Patent Office lost no time in making Mr. Sawyer acquainted with the state of the art, and he was asked to contemplate the invention of Mr. Samuel Gardiner, Jr., patented six years before. The result was that Mr. Sawyer modified his claims so as to distinguish between what was new in his case and what had been done by Gardiner.

To intelligently understand Mr. Sawyer's electric meter we give herewith, in Fig. 3, a diagram view of it.

The meter is designed especially for registering the amount of electricity used in electric lighting plants.

We will suppose no current is passing through the line. In that event, the three magnets (shown in perspective) will not be energized, and consequently their armature will be raised and the pivoted strip, to the right, with which all the armatures are in contact, will be raised also. This pivoted strip carries a tappet which engages a similar one on a chronometer balance (the remainder of the clockwork not being shown). If a lamp be lighted, one of the magnets, which is on that circuit, is energized, its armature lever is attracted, and coming in contact with the pivoted strip, before noted, depresses the latter, thereby throwing the two tappets out of engagement, and imparting an impetus to the chronometer balance which it keeps up so long as the current passes. The same movement also releases the cylinder to the left, which rotates in the direction of the arrow. This cylinder is supposed to be rotated by the clock-work, of which the balance wheel only is shown.

It makes no difference which of the armature levers is actuated; any one (or all of them together), serves to set the clock-work in motion. The clock-work runs only so long as the lamps are used.

Should the lamps be extinguished, the tappets carried by the balance-wheel and pivoted strip will again make

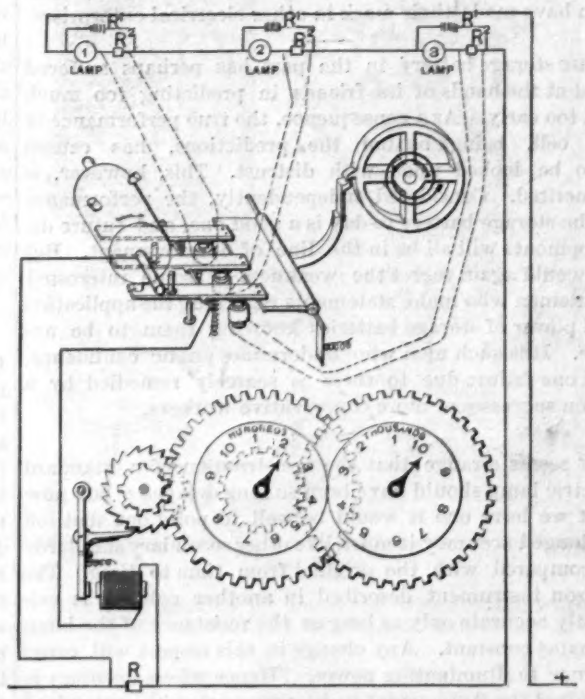


FIG. 3.

contact (none of the series of magnets being magnetized), and the rotation of the cylinder to the left will be stopped.

The rotation of this cylinder has the following effect: The main current, meeting the resistance *R*, a portion is thrown upon the branch, and, the cylinder revolving, one of the projecting pins thereon makes connection with one of the armature levers before noted, and energizes the electro-magnet shown at the bottom of the figure. The current passes from one side of *R* to the other through the cylinder and magnets.

If but one lamp be lighted, the lower magnet attached to the registering mechanism will be energized but once in a revolution; if two are lighted, it will be energized twice, and if three are lighted, three times, and so on.

At each action of this magnet its armature lever is attracted, and, by means of the pawl and ratchet movement shown, causes the ratchet-wheel to rotate one tooth. Thus if but one lamp be in operation the ratchet will move but one tooth in one revolution of the cylinder, and if all the lamps are in use the registering device will be constantly operated by the vibration of the armature.

The Sawyer patent is subservient to that of Gardiner. Its broadest claim is here given for comparison with that of Gardiner:

"In a system of two or more electric lamps or groups of lamps, an electric meter consisting of a registering apparatus and a rheotome or circuit-breaker driven by clockwork or other well-known appliances, and operating to intermittently actuate the registering apparatus, when a lamp or lamps, or group of lamps, is lighted."

In the fall of the same year, J. B. Fuller, of the Fuller Electric Light Company, constructed an electric light meter, an illustration of which is given in Fig. 4.

Fuller devised his electric meter for use in connection with electric lamps, working direct from the dynamo or from a secondary circuit. It may be used with each lamp or be placed near the dynamo in the main circuit, so as to register for all the lamps. The invention is confined in its use, however, to an electric current flowing alternately in circuit in opposite directions.

An armature of polarized steel is placed between two oppositely arranged electro magnets, as shown in the figure, and is connected by a rock-lever to a ratchet escapement so that the motion of the armature will produce a forward movement of the registering mechanism.

The adjacent poles of the two magnets are of opposite polarity; while the current flows in one direction the armature is attracted to one side, and to the other when the current is reversed. This interposed armature is of steel, permanently magnetized. It is attached to a lever having a pawl which engages a ratchet in connection with

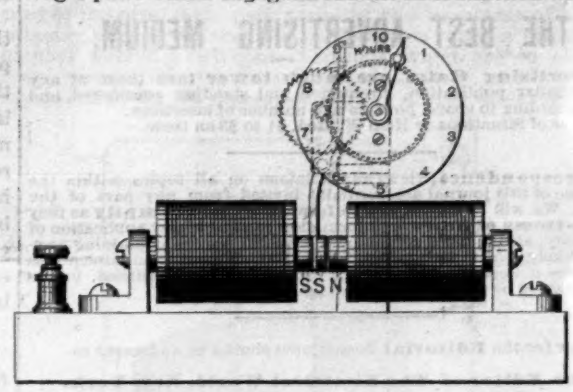


FIG. 4.

the registering apparatus, so that the movement of the armature caused by the change of polarity of the electro-magnets produced by the alternating of the currents will impart a forward movement to the registering mechanism.

The difference between the Fuller meter and its forerunners, the patents to Sawyer and Gardiner, is expressed in the claim of Fuller, which we give herewith. It will be noticed that he confines the use of his device to a meter in connection with an alternating current. The claim reads:

"In an electric lighting system in which the light is produced by alternating currents, an electro-magnet placed in the main or induced current circuit, or in a shunt therewith connected and having a polarized armature, the vibrations of which agitate the train of register wheels."

From the time of Sawyer and Fuller's inventions various styles of electric meters were experimented with, many of which were patented.

(TO BE CONTINUED.)

Influence of Storms on Subterranean Telegraph Lines.

When the construction of the long subterranean lines in France was commenced some years ago, it was thought that their conductors would be quite free from the effect of storms. Accidents are much rarer than with aerial lines, but that they do occur was evidenced by the violent storm on March 9, at the middle of the underground line connecting Belfort with Besançon, when sparks appeared at the two extreme stations. This phenomenon, apparently contrary to the theory of static electricity, M. Blavier thinks, may be explained either as an effect of electro dynamic induction or as an effect of electro-static induction. If the cable is buried only to a small depth in a badly-conducting earth, the sheathing takes, under the influence of storm clouds while the internal wire remains neutral, a more or less considerable electric charge. At the discharge of the clouds this charge becomes free, and escapes into the earth, following the sheathing in two opposite directions. This will develop in the interior conductor two induced currents of contrary directions, the difference of which will act on the apparatus at the end stations. Or the conductor may charge itself from the earth-plates and lightning-guards under the influence of this sheathing charge.—*Abstracts Proc. Institution of Civil Engineers.*

The Franklin Institute Dynamo-Tests.

The results of the recent dynamo tests, as given in our last issue, were obtained by a series of very careful determinations, which leave no doubt as to their correctness. As it is the first public competitive test of dynamos undertaken in this country, the methods employed are of considerable interest, and will no doubt be the subject of inquiry among many of our readers. We present, therefore, a résumé of the means by which the results were obtained:

APPARATUS.

Storage Battery.—This was kindly furnished by Mr. Weston, and was used for all calibrations, measurements of armature resistance, etc. Seventeen cells in series were generally employed. They were placed on boards separated from the floor by porcelain insulators.

Tangent Galvanometer.—This was used for calibrating the current galvanometer. It consisted of a single turn of large-sized wire fastened on the edge of a wooden disc, which was nailed against a square board frame. The ends of the wire were bent up parallel to each other and fastened by brass connectors to the leads. A correction due to the space between the ends of the turn was applied to the mean radius.

FIG. 1.—CALORIMETER, FIXED RESISTANCE, AND POTENTIAL RESISTANCE.

The diameter, about two metres, was measured in different directions, and the mean taken in calculating the constant.

There was a space cut in the middle of the wooden frame, with a shelf for the compass and needle. After the needle was adjusted to the centre and leveled, plumb lines and pointers were arranged so that any warping or change of level could be at once detected.

The value of H was determined by a magnetometer of the coast survey pattern with detached theodolite; it was found to be .1938, and the constant of the galvanometer 31.088 ampères.

External Resistances of Dynamos.—The "dead" resistances for the external circuit of the dynamos were made of German silver strips 1¼ inches wide by about .01 inch thick. They were eight in number, each wound on a frame about 3 feet square by 10 feet high, made of four wooden uprights with pieces framed across at the top and bottom. Porcelain insulators were fastened horizontally to the cross-pieces, and the resistances passed under one of the bottom insulators, over one at the top, to the bottom again, etc. Heavy copper wires were hard soldered to the ends of the strips and taken to the switch-board.

The resistances were adjusted by cutting out part of the strip by a short length of German silver with clamps at the ends, which could be shifted to cut out as many of the turns as was desired. The coils were adjusted by means of a calibrated bridge, to 2·400 ohms at 20° C. There was a good air circulation in the room and fifty ampères could be carried by each coil.

In the same room with the German silver resistances were the racks for the incandescent lamps used for "live" resistances.

Switch-Board.—Two troughs about 2½ feet long and 1¼ inches wide, and 10 inches apart, were cut in a heavy block of wood. Between them were bored two rows of eight holes each, and into these were fitted glass insulators turned upside down to serve as mercury cups. The wood was soaked in boiling paraffine, and melted paraffine poured between the cups and allowed to harden. The distance between the troughs and the middle of the nearest row of cups was 3¼ inches; between the two rows, and the cups in each row, 3 inches. The cups and troughs were filled with mercury, heavy amalgamated copper rods in the latter serving to increase the conductivity. The resistances were brought to opposite cups in the two rows.

The dynamo circuit was from one terminal of the machine to an ordinary Edison switch, by which the current could be made or broken, to one of the troughs; through the resistance to the other trough; to the test house, passing through the fixed resistance for current measurement there; back by the other lead to the dynamo.

Field Galvanometer.—The current in the field of the dynamos was measured by a tangent galvanometer of the Helmholtz type, the coils being each a single turn of large-sized wire. It was calibrated at the same time as the current galvanometer, being reversed as often as possible, and the same end of the needle read on each side of the zero mark.

Wheatstone Bridge.—For measuring resistances that could not be taken to the Johns Hopkins University, a resistance box, with a bridge attachment by Elliott, of London, was used, with Thomson astatic mirror galvanometer.

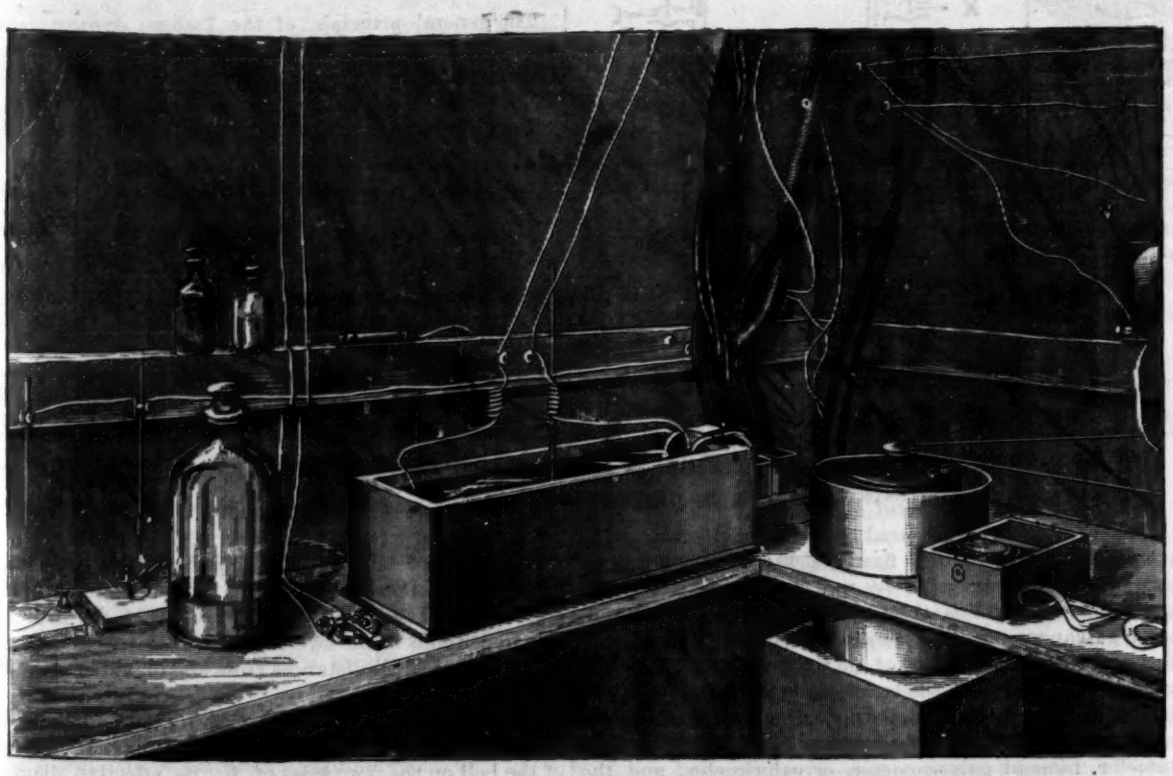


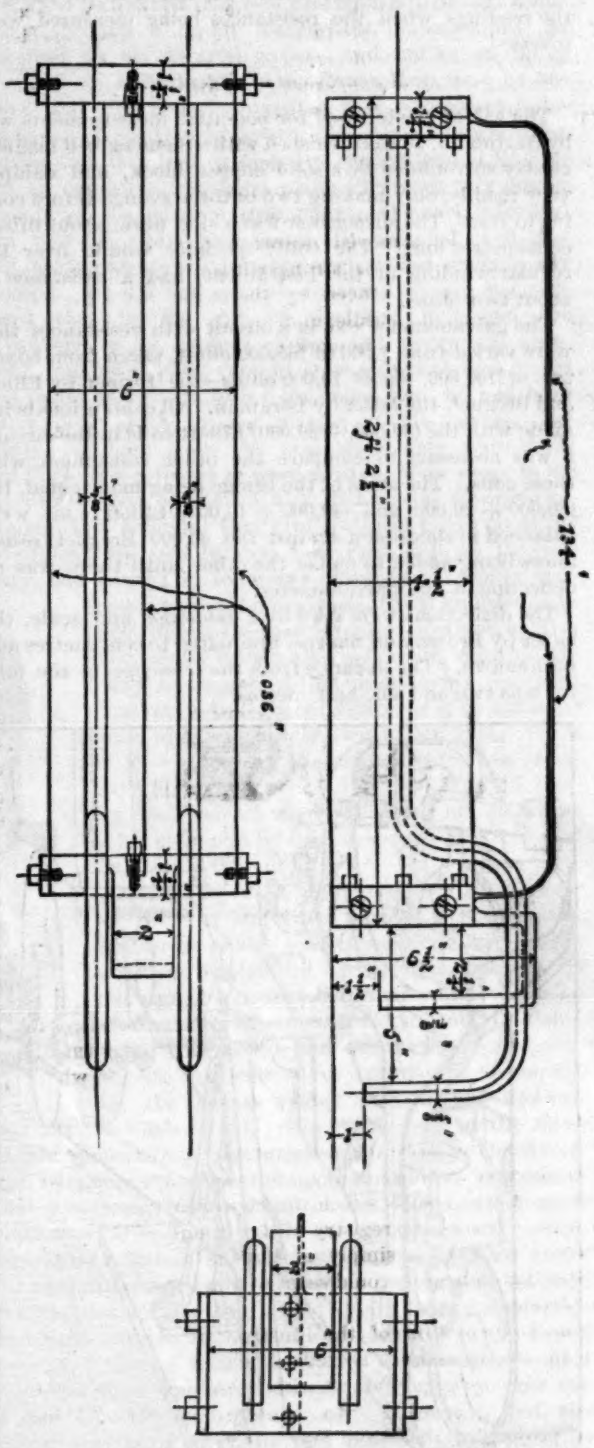
FIG. 2.—TEST ROOM WITH INSTRUMENTS IN POSITION.

Calorimeter.—The calorimeter is shown in Figs. 1 and 2. This was used for calibrating both the potential and current galvanometers; it was made of copper, was cylindrical in shape, about 8 inches in diameter by 10 inches in height, and held about eighteen pounds of water.

The cover was screwed to a flange on the cylinder, the joint being water-tight; in it were holes with raised flanges around them, for the terminals of the coil and the thermometer. For stirring, a shaft, working in a bearing on the bottom of the cylinder and passing through the cover, had on it five paddles arranged along its length and at different angles around it, and bent to throw the water past the wire out to the side of the vessel. On reaching the side a downward motion was given to it by strips of light copper, making an angle of about 30° with the vertical, soldered to the cylinder and projecting inward one and one-fourth inches. On the bottom of the shaft was a propeller blade.

In the first three experiments, copper wire of about 1.3 ohms resistance was used; in the last two, platinum-silver wire of 1.1 ohms. The coil was held in the cylinder as follows: At equal distances around the cylinder, at the top and bottom, were soldered pieces of copper projecting inward, with clamps at their ends. The wire was wound on glass rods held in a light framework; the whole was placed in the cylinder, the rods clamped in place and the framework cut away, leaving a clear space for the stirring arrangement.

The terminals were small copper cups, thoroughly amalgamated and partly filled with mercury. They were surrounded by a rim of ebonite and wedged in their places in the cover.



FIGS. 3, 4 AND 5.—FIXED RESISTANCE.

The calorimeter fitted in a light iron frame, from which it was separated by small blocks of ebonite. The whole was surrounded by a tin cylinder fitting closely on the shelf to which the frame was fastened, so there was no draft past the cylinder.

METHODS OF MEASUREMENT.

Measurement of Resistance.

For the standard resistance, a ten B. A. unit coil by Elliott, which had been compared at the Cavendish laboratory, and was used by Professor Rowland in his recent determination of the ohm, was employed; the values of the resistances in terms of this coil were reduced to the Paris ohm, by dividing by 1.0112.

The bridge used in the comparisons was built at the University workshops, Cambridge, England. Its fixed (equal) arms were connected by a platinum-silver wire bent in a circle, and their ratio changed by making contact with the galvanometer circuit at different points on the wire. Beside the wire was a scale, and on the arm carrying the galvanometer contact a vernier reading to tenths of a division. When the fixed coils were each one ohm, a whole division of the scale meant a change of one part in 10,000 of the ratio, while with the galvanometer used, a

change of one-tenth of a division, or one part in 100,000, could be detected.

The different coils to be compared were balanced against resistances taken from "comparators," designed by Professor Rowland. Each of these consists of ten coils of equal resistance wound together on a copper cylinder, the whole being coated with wax or paraffine and put inside a larger cylinder, the space between being filled with feathers.

Three comparators of ten, 100 and 1,000 ohms were used, giving a range of from one to 10,000 ohms.

Each coil of the ten-ohm comparator was balanced directly against the ten-ohm standard, then the ten coils in series were balanced against each of the 100-ohm coils, and finally the 100-ohm comparator in series compared with each of the 1,000-ohm coils. In the measurements, the inner cylinders of the comparators were filled with water and the standard immersed in water, the temperatures being noted.

The zero of the bridge scale was taken as the mean of the readings when the resistances being measured were reversed.

Measurement of Potential.

The galvanometer used for potential measurements was by Hartmann. It was furnished with a Siemens' bell magnet, closely surrounded by a solid copper block, and damped very readily, only making two or three swings before coming to rest. The suspension was a silk fibre about fifteen centimetres long. The coils, specially wound over the regular winding of the instrument, had a resistance of about two ohms.

The galvanometer was in a circuit with resistances that were varied from 1,000 to 150,000 ohms, taken from boxes, two of 100,000, one of 10,000 ohms—the former by Elliott and Breguet, the latter by Bergman. All calibrations being made with the (30,000 + 20,000) Elliott coils in the circuit, it was necessary to compare the other resistances with these coils. The arms of the bridge being made equal, the (30,000 + 20,000) and (40,000 + 10,000) Elliott coils were balanced in succession against the 50,000 Breguet, resistances being added to one or the other until there was no deflection of the galvanometer.

The deflections were read by a telescope and scale, the latter by Brown and Sharpe, graduated to centimetres and millimetres. The distance from the telescope to the mirror was two and one-half metres.

took from ten to twenty minutes, the deposit ranging from .9 gram to 2· grams. The times were noted by a chronometer whose rate, + 1 second per day, was neglected.

When the experiment was finished, the solution was poured out of the crucible; the deposit first washed with distilled water, then allowed to soak from one-half hour to twelve hours, then washed again until there was no precipitate with a solution of sodium chloride, and finally slowly dried and then weighed.

A double reading of the galvanometer was taken each minute, and the constant calculated from the mean reading for the time of observation.

Calorimeter Calibrations.—The calorimeter has been described. In making the observations, the time the mercury crossed each half degree or centimetre of the thermometer was taken as the mean of the times of crossing the tenths before and after the division, and the division itself. In calculating the water equivalent of the calorimeter, the weight of the shaft was multiplied by the specific heat of steel; that of the cylinder by the specific heat of copper, and the weight of the glass and wire, by

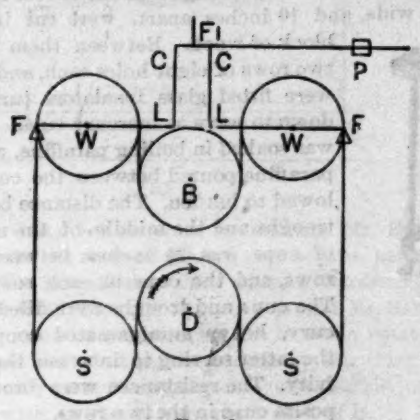


FIG. 6.

their specific heat. For steel, the value of the specific heat was assumed to be .1110, and that of copper .0940.

The principal correction to be applied is due to radiation. The other corrections are for rise of temperature from stirring, for the part of the thermometer stem in the air, and a small one for weighing in air.

The coefficient of radiation was determined by noting the rate of cooling, the calorimeter being slowly stirred.

The galvanometer was read with a mirror and scale, the latter being of porcelain, graduated to centimetres and millimetres. The distance from the galvanometer was 2.5 metres.

Resistance Box.—The resistance box, by Hartmann, being open at both ends and having no paraffine on the coils, was very well fitted for its work. Its measurement has been described.

Fixed Resistance.—The details of the fixed resistance are shown in Figs. 3, 4 and 5, which are respectively, a plan, side elevation, and end view. It is also shown in perspective in Figs. 1 and 2. It consisted of three strips of German silver, 4½ inches broad by .036 inches thick, the ends hard-soldered into heavy copper blocks.

One of the blocks had a terminal piece cast on it that was bent to clear the edge of the tank in which the resistance was placed, and dipped into a mercury cup, to which one of the main leads was brought. From the other block, two copper rods passing between the strips were bent over the edge of the tank and dipped with the other main lead into another mercury cup. The terminals of the galvanometer circuit were soldered into the copper blocks and remained perma nent during the tests. The whole was put in a rectangular tank filled with the same kind of oil as was used for the potential resistance.

Calibrations.—Calibrations were made by sending a current through the fixed resistance, measuring it, observing the deflection of the galvanometer and the resistance in its circuit, and noting the temperatures. The calibrations usually lasted ten minutes. The constant was calculated by the formula already given.

Three methods of measuring current were used—the silver voltameter, tangent galvanometer and calorimeter.

For the voltameter calibrations, a large platinum dish was used as cathode, a flattened spiral of silver wire wrapped with filter paper as anode, while a forty to fifty per cent. solution of silver nitrate was employed. With this strength of solution, and with the usual current, about four ampères, the deposit was very regular and beautiful. It was treated as described under potential measurements. The resistance in the circuit was about ten ohms.

The tangent galvanometer has been already described. Two observers read both ends of the needle on each side of the zero mark. The current was reversed every minute; it varied from 20 to 30 ampères.

The method of using the calorimeter has been described. The observations give $C^2 R$, and R being measured by the bridge, C may be found, with the advantage that errors of observation are halved, in the value of C.

This principle of measuring current has been used before, notably at the Vienna and Munich exhibitions, but as employed in the tests the method differs from that previously used in an important particular, *i. e.*, the construction of the fixed resistance. The substitution in the fixed resistance of German silver strips in oil instead of the copper bars in air formerly employed, increased greatly both the range and accuracy of the method.

Power Measurements.

The general principle of the Tatham dynamometer is shown in Fig. 6. The power applied to the shaft on which the driving pulley D is fixed, is transmitted to the pulley B, to whose shaft the machine to be tested is coupled, by an endless belt, which passes over D, under the stretching

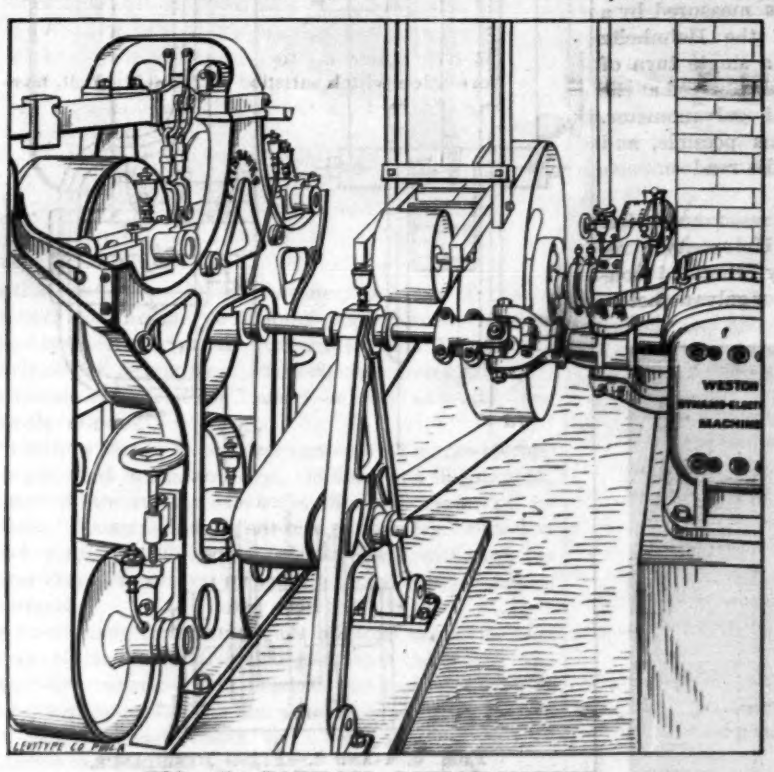
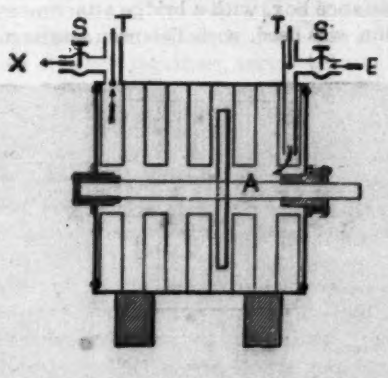
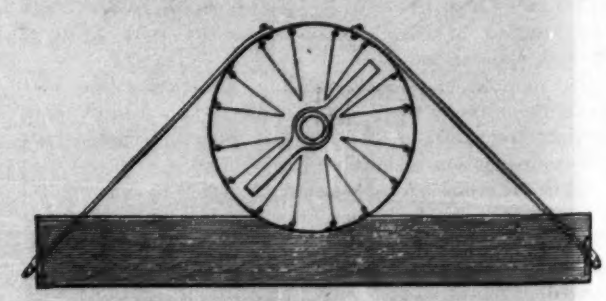


FIG. 7.—TATHAM DYNAMOMETER.





FIGS. 8 AND 9.—POWER CALORIMETER.

Calibrations.—The galvanometer was calibrated, both by measuring a current passing through a standard resistance at whose terminals the leads of the instrument were connected; and by the difference of potential at the terminals of a calorimeter. The constant was also checked with that of the current galvanometer, after each test, by measuring the current through the German-silver strips used for the external circuit of the dynamos, and the potential at their extremities.

Voltameter Calibrations.—The current used varied from one to one and one-half ampères, giving a difference of potential at the terminals of the standard coils of from twenty to thirty volts. The coil shown in Fig. 1 was of No. 22 German-silver wire, wound on glass rods fixed in a wooden framework. The turns were kept apart by silk cord wound on the rods. The whole was immersed in a high-grade oil (300° fire test) kindly furnished by the Standard Oil Company. The oil was constantly stirred while the current was passing. The measurement of the resistance has been described. Its value was 21·161 ohms, at 14° C.

For measuring the currents, a silver voltameter was used, the anode being a spiral of silver wire wrapped in filter paper, the cathode a platinum crucible filled with a 40 per cent. solution of silver nitrate. The calibrations

Measurement of Current.

The currents were measured by observing the ratio of the potentials at the ends of a fixed resistance when a known current and the current to be measured were passing respectively. To do this, the terminals of a circuit containing a galvanometer and a resistance box were permanently fastened to the extremities of the fixed resistance. A current was sent through the latter, and the resistance of the box adjusted until the proper deflection of the galvanometer was obtained; the current was measured by the voltameter, tangent galvanometer, or calorimeter, and the deflection and resistance were observed. When any other current was to be measured, the box was changed until the deflection was about the same as before, and both the deflection and resistance noted.

Galvanometer.—A mirror galvanometer, by Edelmann, of Munich, was used. It was furnished with a ring-magnet damped by surrounding copper blocks. The suspension, originally about two feet long, was shortened to about seven or eight inches by a copper rod passing inside the glass suspension tube; there was no trouble from vibrations. The coils were movable on graduated bars, but for the tests they were clamped and their position never changed. The resistance of the coils, with the fixed resistance and the leads to it, was .3973 ohm 25°.

pulley S, over the weighing pulley W, under B, over the second weighing pulley W, under S, back to the place of starting. Each of the weighing pulleys W is supported in a cradle, the outer end of which is pivoted on the knife edge F, while the inner end is supported by the link L C. The upper ends of the two links are fastened to the scale beam F P, at equal distances from and on either side of the fulcrum F.

To calculate the power applied to the pulley B it is necessary to know three things: The difference of tension of the belt on the two sides of B, its effective diameter, and its number of revolutions.

The scale beam is acted upon through the links L C, fastened to the cradles of the weighing pulleys W. The tensions of the belt on the outer faces of these pulleys have no effect on the beam, since the line of effort of the belt passes through the knife edges F. The only forces then that act on the beam are the two tensions of the belt on the inner faces of the pulleys W, *and these are the tensions on the two sides of* B; and the links being at equal distances on either side of F, the *difference of the tensions* is recorded on the beam.

The scale beam was of steel, graduated by Brown and Sharpe into 600 divisions. With the weight used each division meant one-half pound. A small poise traveling

on the weight allowed readings to be taken to $\frac{1}{100}$th of a pound.

A very ingenious mechanical counter registered the number of revolutions. Observations could be taken each minute, and the counter recorded continuously to 1,000,000 revolutions.

Having the difference of tension on the two sides of *B*, its delivery per turn, and number of turns per minute, the horse-power was calculated as follows:

$$\text{Horse-power} = \text{divs. scale beam} \times \text{no. revs.} \times \frac{66\ (1.0025)}{2 \times 33000}$$

$$\text{Horse-power} = 1.0025 \left\{ \frac{\text{divs. scale beam} \times \text{no. turns p'r m.}}{10{,}000} \right.$$

To avoid the uncertainty of loss due to belting, the shaft of the driven pulley *B* was coupled directly to the dynamo by a universal coupling, as shown in Fig. 7. It was assumed that this would allow for any slight inexactitude in lining the dynamo and dynamometer shafts, but it is doubtful if it was of much value at the high speeds used for the tests.

The figure of the dynamometer gives a view of it as used in these tests. The automatic recorder for the scale beam, shown in the figure, was not used. In making observations, the number of revolutions and scale beam were read each minute, usually for ten minutes. The means of the two sets were multiplied together, the product divided by 10,000, and a correction of one-fourth per cent. applied, as given in the formula.

Mr. Tatham has published a paper.* giving the principles involved in the dynamometer, and describing its various modifications of form.

Checking the Dynamometer.

In order to make the tests absolutely as well as relatively accurate it was decided to check the work recorded by the dynamometer against an amount of work calculated from the mechanical equivalent of heat.

To do this a calorimeter was constructed, the general plan of which is shown in side and end section in Figs. 8 and 9.

It was of wrought iron, 3 feet long by 3 feet in diameter, with V-shaped projections riveted inside the shell. The paddles, 30 inches long by ¼ inch thick, were keyed to the shaft and moved between the Vs. One end of the shaft passed through the end of the calorimeter, and was coupled to the dynamometer. In the experiments but one paddle was used, 700 revolutions absorbing about forty-five horse-power.

Two different methods of experiment were employed; first, with a constant weight of water and an increasing temperature; and second, with a constant temperature and a continuous flow of water through the calorimeter.

An Electrical Standard of Light.

The uncertainties of and corrections required when employing candles as the standard of light have led to numerous other forms of standards in which gas and oils are used under various conditions. Some time ago Mr. Edison was asked to devise an electric light standard for the use of photographers, and as the result of his labors the instrument made by the Stout-Meadowcroft Company, of this city, and shown in the accompanying illustration, was constructed.

The problem evidently resolves itself into the question of obtaining a steady light (of known candle power) and a uniform current from a variable battery, with lamps of varying resistances.

The method employed consists in graduating the electromotive force of the lamp accurately to a constant value, and the arrangement used for this purpose is based upon the compensation balance of Poggendorf.

In this method of measurement, as is well known, the currents from two batteries are so balanced by the insertion of a variable resistance that, if a galvanometer is inserted in the circuit, no traces of a current can be perceived.

The arrangement, as shown in the cut, consists of a standard constant battery, a galvanometer, a key, a rheostat or resistance wire made in two sections, two adjustable runners which connect the main and constant batteries with the lamp and galvanometer, and a switch, all fixed on a base supported by a metallic tripod. There are four binding-posts, which, being placed behind the constant battery, are not shown in the engraving. To two of these binding-posts are connected the wires leading from the main battery, and to the other two are attached the ends of a flexible wire leading to an Edison lamp which may be placed in a photometer.

The main battery is used for lighting the lamp. The galvanometer is in circuit with both the main and constant battery. In the lamp circuit is a switch for turning the current on or off.

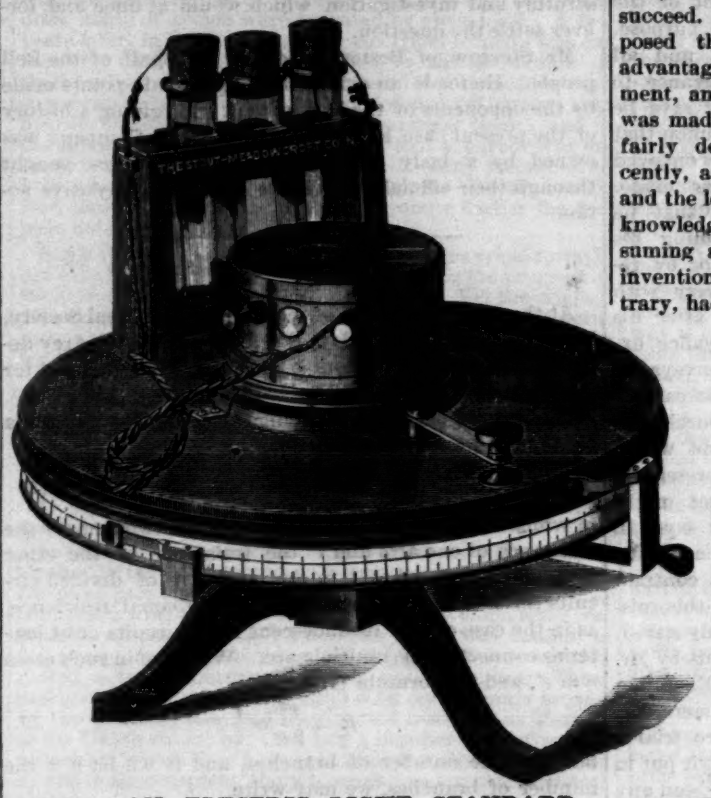
There are two sections of German silver wire placed round the edge of the base, the lower section lying upon a millimeter scale, to any point of which the runner may be adjusted, according to the number indicated on the ticket accompanying each lamp.

The circuit of the main battery is from the carbon or positive pole to the lower resistance wire and then back through the lamp to the negative or zinc pole. It will be seen that by sliding the runner the resistance may be increased or diminished.

The circuit of the constant battery is from the positive or copper pole through the key to the upper resistance wire, through the galvanometer and back to the negative pole. Here, also, the resistance may be increased or diminished by adjusting the runner.

There is thus a section of the resistance wire (the amount between the end connecting with the key and the runner on the lower resistance wire), through which the current from each battery flows; and although the current from the main battery has a circuit independent of the galvanometer, it is in this section of wire that both currents are brought into juxtaposition and the electromotive force of the main battery compared with that of the constant battery. The variation is at once noticed on the galvanometer, and is easily regulated.

In operating the lamp, the switch in the lamp circuit is first turned on, then the key is pressed, which brings the current of the standard battery into opposition with the current from the main battery, through the galvanometer. If the electromotive force of the main battery is too weak, the needle of the galvanometer will be sent to the right of zero a few degrees by the constant battery, but such movement is at once overcome by diminishing the resistance in the main circuit through the sliding of the runner on the lower wire toward the left. As quickly as the resistance is cut out by this movement, the needle of the galvanometer is forced back to the left until it reaches the zero point; then the batteries are exactly balanced, and the light obtained is equal to that of a standard candle; at this zero reading we have also a constant number of volts of electromotive force.



AN ELECTRIC LIGHT STANDARD.

So delicate is the balance that the resistance of a quarter of an inch of the resistance wire can be read on the galvanometer.

As indicated above, each lamp is provided with a number indicating the fixed position of the runner on the lower scale. This number is the result of a standardizing of the lamp, and, of course, varies somewhat with the varying resistance of every lamp.

By these means a one-candle standard can be conveniently maintained, and the instrument will, no doubt, find numerous applications among photographers, in the laboratory and photometrical room.

Professor Gray's Claim to the Telephone.

The hearing at Washington, before Secretary Lamar, on the petitions that the United States should bring suit to annul Mr. Bell's patent, continued last week. It cannot be said that much was developed new to the readers of this paper. The most important matter presented was the affidavit of Prof. Elisha Gray, made on the 9th inst. Professor Gray begins his affidavit with the statement that in the year 1876 he conveyed a number of his patents, supposed, among other things, to relate to telephony, to the Harmonic Telegraph Company, in consideration of a stock interest in that company. These patents were then conveyed to the American Speaking Telephone Company by the Harmonic Company for the consideration of one-third of the stock of the American Company. Mr. Gray states that the American Telephone, the Gold and Stock, the Harmonic, and the Western Union Telegraph Company were the real defendants in the suit of the American Company known as the Dowd case. Some time after the institution of that suit, says Prof. Gray, these companies combined in joint ownership of all the patents involved, the American Company receiving in the compromise 20 per cent. of the royalties received and to share in the expenses of litigation and purchase of other patents. Before the combination was effected, and when it was understood that a compromise would be made, Prof. Gray believes that the litigation was not carried on in good faith with a view to a final settlement by the court. This, he says, resulted from the expectation of a compromise, and after it had been effected everything was done for the benefit of the parties and such decree as they desired was entered in the case. Prof. Gray had no control over this case at any time, and his interest was represented by the combination in which he was interested. He filed a caveat for a telephone on Feb. 14, 1876, and afterward learned that Prof. Bell on the same day filed an application for an improvement in "multiple telegraphy." He learned, but not until after Bell's patent had been issued, that in it he claimed to have invented a telephone. The affiant then reviews the circumstances attending the dismissal of the interference between himself and Bell and the issue of a patent to the latter.

Continuing, he says he is informed and believes that in a few days after the issuance of that patent Bell made an instrument with which he transmitted speech. Long afterward he learned that Bell first transmitted articulate speech through a liquid transmitter, substantially as described in his (Gray's) caveat, and unlike anything described in Bell's application. For a long time he believed that Bell actually invented that instrument independently of his (Gray's) device. He (Gray) informed his counsel that Bell had exhibited at the Centennial Exposition an operative telephone, using a receiver very nearly resembling his (Gray's) instrument. Counsel informed him that his claim was practically defeated, and that Bell, having an operative instrument, would undoubtedly succeed. He did not suspect anything wrong, but supposed that in the eye of the law Bell had the advantage, as his counsel stated, and every oral statement, and every letter coming from affiant at that period was made or written under the belief that he had been fairly dealt with in the matter of his caveat. Recently, and long since the oral statements were made and the letters referred to were written, facts came to his knowledge that convinced him that he was wrong in assuming and believing that Prof. Bell had fairly made his invention. He now believes that Prof. Bell, on the contrary, had learned in some way of his caveat and its contents, and that he made use of that knowledge in constructing the instrument with which he first successfully transmitted articulate speech. He (Gray) had supposed that his discovery remained a secret in the Patent Office, as it should have done, and was not known to Mr. Bell. What he now states on the subject is in view of information which satisfied him that Mr. Bell, having obtained his secrets, claimed his discovery as his own, and by this means got the credit of his (Gray's) invention.

Acting, however, says Professor Gray, under the belief of Mr. Bell's fairness in the matter, and under advice of counsel as to his rights, as before explained, he made such statements and gave such depositions as would seem to acknowledge Professor Bell's invention. Being under this belief, he did not take steps to file his application on his caveat promptly, but the matter rested without any application until November, 1877. Some time prior to the filing of said application it was suggested to him by the American Speaking Telephone Company, under the impression that it was the owner of the caveat, that an application had better be filed upon it, and the application was accordingly filed. Before any further steps were taken under the application, except to declare an interference between the application and the Bell patent, the compromise had been effected between the contestants in the Dowd case, and acting under the belief that by conveyance the American Speaking Telephone Company was the owner of the application and the caveat and the rights therein mentioned, and that whatever interest he had was only as a stockholder in the American Speaking Telephone Company, and that he had no longer any financial interest in pressing the interference suit, Mr. Gray declares that it was immaterial how the contest was terminated, provided it was done in such a way as to subserve what was believed to be the common interest of the combination. After the combination, and without any action on his part, the interference suit was again set in motion and conducted to a result. He had no counsel employed and took no interest in it, only giving his deposition when called upon by the combination. The whole apparent controversy was, as he now believes, collusive and carried on with the appearance of an array of opposing counsel; that those counsel all understood each other and were working for a common end agreed on beforehand by the combination. He had deposed under the honest belief that Mr. Bell had the advantage.

"It is not a fact," continues Professor Gray, "that the result of the Dowd case was reached by a trial upon the merits, and a decision according to the merits, but it was reached by the agreement and understanding of the parties in interest. Nor is it a fact, as I believe, that the interference suits were carried on upon their merits in a real bona fide controversy, but, on the contrary, I believe that said interference litigation, although seemingly hostile, was really friendly, and the result reached was not a

* Journal Franklin Institute, December, 1882. Vol. CXIV.

decision upon the merits in a hostile controversy, but in a collusive controversy, in which the only parties interested were the parties in interest in the Dowd litigation." In the correspondence that passed between Professor Bell and Professor Gray in 1877, Professor Gray says he accorded to the former credit as an actual discoverer and inventor, under the belief, however, that he was entitled to priority, and that without any knowledge of his (Gray's) caveat he had really been enabled to appear to be a discoverer and inventor, when such, as he now truly believes, was not the fact. Mr. Gray says further that he wrote then under the belief and by advice of counsel, that, by reason of Mr. Bell's claim to have filed his application before his (Gray's) caveat, therefore Bell's claim would take rank over his. He says that the letter he wrote to Professor Bell, giving him credit as the original inventor, was written long before he knew that his first transmission of articulate speech was with a liquid transmitter like that described in his (Gray's) caveat, and that when he wrote the letter, and also when he exhibited the instrument in Chicago as Professor Bell's invention, he only knew of the transmission of speech made at the Centennial with the instrument made like his receiver, which he had never used as a transmitter. The opening and concluding arguments of the counsel who nominally represented Professor Gray in the interference cases, but who, he says, really represented the combination in that suit, conceded the discovery of the broad art to Mr. Bell, and claimed for Professor Gray only a device or improvement on that art. Mr. Gray says he did not know until a long time after that such was the case. The arguments in the case, he says, are in harmony with the main intent of the combination, and were made to carry out its purpose. The combination claimed Mr. Gray's caveat and all the rights thereunder by virtue of his conveyance to the Harmonic Telegraph Company. Mr. Gray says he did not intend to convey it, as he was of opinion that he had been overreached, or had by mistake conveyed more than he intended when the trade was made. Mr. Gray says that after he was informed that he had been wronged in the Patent Office touching his caveat, either by design in disclosing his secrets or by remissness or accident, and that it was his discovery with which Prof. Bell first transmitted speech, soon after his (Gray's) caveat was filed, he had the said conveyance examined by counsel and was advised that said conveyance did not cover the caveat, but only certain specific patents then granted, and which it was supposed by the purchasers to relate, among other things, to telephony, and which patents they believed, although not granted expressly in reference to that art, yet embraced principles that might be controlling in contests touching it. Mr. Gray says, in conclusion, that he was misled by the assumption on the part of said company and its assignees that his contract covered said caveat, and that he labored under this mistake until he had the contract examined, as already stated.

This affidavit was objected to on several points by Mr. Storrow, as might be expected. In answering Examiner Wilbur's affidavit, put in evidence by the petitioners, Mr. Storrow read from the record of the Baltimore trial a second affidavit made by Wilbur after the affidavit put in by the petitioners, and denying that there had been any collusion between himself and Professor Bell. An affidavit by Lieutenant Guy, of the district police, was presented, to show that Wilbur had been arrested many times last August for intoxication, and on at least two occasions between the making of the two affidavits for the Memphis citizens. An affidavit by ex-Commissioner of Patents Speare, wherein he declares that all of the proceedings attending the issue of the Bell patent were regular in form, was also read. Among other affidavits presented during the week was one from President Goodwin, of the Globe Company, testifying to Meucci's poverty, alleging that he was oppressed by the Bell Company, by the institution of a suit against him, and asserting that the company had tried to purchase and acquire Meucci's claims, through its attorney, a Mr. Tomp kins. In answer to this allegation that the Bell Company had attempted to buy Meucci's claims, Mr. Storrow said that he could produce letters to show that the Bell Company had been invited to go to Philadelphia to negotiate with the Globe Company, and that they had sent down a representative, but the Meucci people had declined to show him anything, and he returned no wiser than he went. Mr. Beckwith was ready to put in a counter affidavit, sworn to by five gentlemen, to the effect that no such invitation had been extended by the Globe Company; that the Bell representative had called upon Mr. Goodwin and associates and had spoken of millions of money, and that the gentlemen representing the Globe Company had drawn their watches and given the Bell representative 20 minutes to leave.

As to the instruments exhibited, Mr. F. L. Pope, on behalf of the Bell Company, stated, in an affidavit, that after carefully comparing the drawings of the Reis apparatus with the instruments alleged by the petitioners to be constructed in accordance with these drawings, that essential modifications had been introduced, consisting of features of construction found in telephone instruments which have been invented since the issue of the Bell patent. The most important of these is the mounting of contact point upon an inertia weight carried at the end of a delicate spring, which is the improvement patented by Blake in his well-known transmitter. The contact surface of the Reis instrument is formed of carbon, a substance the peculiar adaptability of which to this purpose was not discovered until 1878. There are other modes in the details of the construction of the Reis telephone, all of which, Mr. Pope says, tend to approximate it to the modern telephone apparatus, and to depart from the construction and mode of operation of the original apparatus of Reis.

Mr. Randall, on the other hand, in his affidavit, maintains that the Reis apparatus is a speaking telephone, independent of these modifications. The argument was begun by Mr. Humphreys, of the Globe Company, opening. He argued that the opposing companies could not obtain a fair judicial investigation of this matter, except by a suit instituted by the government. Dr. Beckwith argued in support of the claims of Meucci as the inventor of a telephone in 1855, and insisted that his client could not obtain his rights unless aided by the government.

Congressman Casey Young, of Tennessee, representing the Memphis and New Orleans petitioners, argued that the government had a right to bring a suit to vacate or set aside the Bell patent, and cited a number of precedents authorizing action of this character. He maintained that the Bell patent was too broad in its character, as it endeavored to secure the exclusive right to a force of natural electricity. The infringement cases growing out of Bell's application were not finally settled until four years later. He saw no reason why the Bell people should fear a trial in the courts if the government instituted proceedings, when in eighteen suits in different courts they had already succeeded. On the contrary, he thought they ought to court a judicial scrutiny and investigation which would at once and forever settle the question.

Mr. Storrow, of Boston, followed in behalf of the Bell people. He made an exhaustive reply to all points made by the opponents of the Bell patent. In giving a history of the present case he said the Pan Electric Company was owned by a body of Congressmen, who now sought through their official capacity to influence executive action.

Buffalo Electrical Society.

At the regular meeting of the Buffalo Electrical Society, held at their rooms, Friday, Nov. 6, Prof. A. L. Arey delivered the ninth of his course of lectures, the subject for the evening being "The Divided Circuit."

The lecturer began by deducing the well-known formula for the resistance of a divided circuit

$$R = \frac{r\,r'}{r + r} \qquad (1)$$

in which R = the joint resistance of the two arms, r the resistance of one arm and r' the resistance of the other arm, and continued that in the majority of divided circuits the several arms or branches are of equal resistance, as in the case of the incandescent lamp circuits or of batteries connected in multiple arc. We have in such cases $r = r'$, and the formula (1) becomes:

$$R = \frac{r^2}{2r} = \frac{r}{2}$$

but 2 is the number of branches, and if we let n = the number of branches, we may write

$$R = \frac{r}{n} \qquad (2)$$

by means of which we may determine the resistance of any equally divided circuit.

To illustrate the application of this formula, the following problem was solved:

What will be the resistance of 900 incandescent lights, each having a hot resistance of 130 ohms, connected in simple multiple arc?

Substituting in the formula

$$R = \frac{130}{900} = .144 \text{ ohms.}—\textit{Ans.}$$

After applying this principle in connection with Ohm's law to several more complicated problems, Mr. Arey stated that the consideration of a large class of problems seemed to have been overlooked by the various writers on electricity, and gave the following deduction of formulæ for the determination of the number of cells of a given battery which will produce a given current through a given external resistance, and the manner in which they must be connected.

In problems of this kind we have given:

C = the current desired.
R = the external resistance.
e = the E. M. F. of the cell.
r = the internal resistance of the cell.

Let

x = No. of cells in series.
y = No. of rows of cells.
ρ = internal resistance of battery.
E = the E. M. F. of the battery.

By Ohm's law we have:

$$C = \frac{E}{P + R} \qquad (3)$$

but the E. M. F. of the battery is equal to the E. M. F. of one cell, multiplied by the number of cells in series, hence

$$E = ex,$$

substituting in (3)

$$C = \frac{ex}{\rho + R} \qquad (4)$$

and since the maximum current is obtained from a given battery when its internal resistance is equal to the external, we may determine the smallest number of cells which will produce the given current by making $\rho = R$ in equation (4)

hence
$$C = \frac{e\,x}{2\,R} \qquad (5)$$

$$\therefore \quad x = \frac{2\,C}{e} R \qquad (6)$$

The resistance of the given battery will be

$$\rho = \frac{r\,x}{y} \qquad (7)$$

but since $\rho = R$ we may write

$$R = \frac{r\,x}{y} \qquad (8)$$

Clearing of fractions

$$y = \frac{r}{R} x \qquad (9)$$

substituting the value of x found in (6) in equation (9) we have

$$y = \frac{r}{R} \times \frac{2\,C\,R}{e}$$

whence

$$y = \frac{2\,C}{e} r \qquad (10)$$

and we may obtain the number of cells which must be connected in series by the equation (6),

$$x = \frac{2\,C}{e} R$$

and the number of such series by equation (10),

$$y = \frac{2\,C}{e} r$$

Of course the number of cells used will be equal to x multiplied by y.

It is evident from an inspection of the formula that the number of cells in series depends upon the external resistance, while the number of such series depends upon the internal resistance of each cell.

In conclusion, the following problem was solved to illustrate the application of the formulæ: How many gravity cells will be required to send a current of 10 ampères through a resistance of 5 ohms, and how must they be connected, assuming the E. M. F. of each cell equal to 1 volt and its internal resistance 1.5 ohms?

Substituting in (6) and (10)—

$$x = \frac{20}{1} \times 5 = 100.$$

$$y = \frac{20}{1} \times 1.5 = 30.$$

Therefore the number of cells required will be 3,000, connected in 30 rows of 100 each.

Figures of the T. M. B. A.

We are indebted to Mr. C. P. Bruch, the courteous and efficient secretary of the Telegraphers' Mutual Benefit Association, for the subjoined summary of the report for the fiscal year ended October 31, 1885.

Receipts.

Cash balance from previous year	$5,720.02	
From assessments and fees	30,504.21	
From interest on reserve fund and surplus	2,819.20	
From sale of bonds on account of reserve fund	37,062.00	
		$76,105.43

Disbursements.

On account of death claims	$25,000.00	
On account of working expenses	2,872.13	
Purchase of bonds for reserve fund	35,000.00	
Loaned on account of reserve fund	4,000.00	
		$66,872.13
Balance cash on hand		$9,233.30

Assets.

Balance cash on hand, as above	$9,233.30	
Due on account of assessments, fees, etc	5,705.42	
Reserve fund	42,000.00	
		$56,938.72

Liabilities.

Payable account of death claims, not yet due	4,800.00
Balance net assets	$52,138.72
Present membership	2,872
Net increase during year	106

One More Cable Proposed.

Articles for the incorporation of the German-American Telegraphic Cable Company, with a capital of $12,000,000, have been filed at Albany. The five trustees, whose signatures are affixed, are Henry Waterman, Ruel Phillbrook, Benjamin F. Bradbury, George D. Rice, Humphrey B. Wyman, residents of the cities of Boston and New York. The company is to extend its lines between Germany and the United States and between Germany and England. The object is to construct and operate a telegraphic cable between some suitable point at or near Boston, Mass., to some point to be designated by the Emperor of Germany for the landing of the cable. A further object is to cheapen or lessen the expense in operating the cables, as well as receiving and transmitting messages, cablegrams or other communications from country to country along such telegraphic line or lines, so that merchants, bankers, brokers, newspapers and all other kinds of business men, as well as government, post-office or other officials, may have prompt, safe and economical service. The twelve million capital is to be divided into shares of $25 each, numbering 480,000 shares. The charter is to extend fifty years. Twelve directors are be elected by the five trustees. The office of

the company is to be in New York City, with branch offices in Boston and Berlin.

There may be issued and sold in the market at the par value stated thereon, coupon bonds of the German-American Telegraphic Cable Company for the full amount of the capital stock, or of any increase in the capital stock bearing interest at the rate of 5 per cent. per annum, payable in gold semi annually at either Boston, New York or Berlin. The bonds are to run thirty years. The stock and bond books are to be immediately opened to receive subscriptions to the capital stock and for the bonds of the company in America and Germany, at such places as the President may designate. The trustees are to meet and elect directors within ninety days.

New York Electrical Society.

At the last meeting of this society, held on the evening of Nov. 11, President Van der Weyde read an interesting paper on a method of obviating the inaccuracy connected with the use of the differential galvanometer. He employs a double switch by means of which he shunts the divided currents alternately into the opposite coils of the galvanometers, and then takes the mean of the two readings.

He applies the same principle to the Wheatstone bridge, by alternating in the same way the relative position of the two fixed arms of the bridge.

American Institute Exhibition.

In addition to the electrical exhibits at the above place, of which we made mention in a recent issue, there are several others which have since attracted our attention. Among them is the 60-light Edison incandescent plant, the dynamo of which is run by a 6 h. p. upright automatic engine of the New York Safety Steam Power Company.

The Rousseau Electrical Works, of this city, show a full line of electrical goods, such as burglar alarms, push buttons, annunciators, electric gas lighting apparatus, etc. This exhibit also contains an elegant Holtz machine, from which a young man, mounted on an insulating stool, distributes shocks to the unwary.

The Automatic Temperature Regulator of Mr. C. A. Tucker, of Brooklyn, is shown in operation. It is so arranged that a rise in temperature above a certain limit, acting upon a thermostat, closes an electric circuit, which causes the opening of ventilating slats in the window.

The "Electric Light Belts" of Messrs. Chas. A. Schieren are on exhibition and in operation in various parts of the building.

The Right to the Name of Jenney.

To the Editor of The Electrical World:

SIR: It is very cheap bluster for a man who is sued, to rush into print with the pretense that he was just going to sue the other fellow, as does Mr. Brainard Rorison in his communication published in your paper of the 31st ult.

The suit to which he refers is no mere rose-water issue over a name, as he would have the public believe.

The Fort Wayne "Jenney" Electric Light Company has sued Mr. Rorison individually and personally, along with his company, for dishonest and fraudulent conduct—for downright lying, "not to put too fine a point on it." Its charges are on file in black and white, and Mr. Rorison will do well to clear himself from them before asking the public to take much stock in his unsupported statements.

Since the publication of his communication the Star Iron Tower Company has also sued Mr Rorison and his associates in the U. S. Court for infringement of patent. Had he instructed his attorney to sue that company, too?

I am aware that such controversies as this are of no interest to the public. I have not invited it, and will dismiss it with a word.

Charles D. Jenney is a young man just past twenty-one. He came into our employ at the age of seventeen with his father, James A. Jenney. We paid him for all he ever did for us. By the time he became a man he had conceived notions of his own genius and importance that seemed to us to be extravagant, so we parted. He was picked up by Mr. Rorison, and his name made the stock in trade of a company which seeks to push itself into business upon the reputation made by us, and by false and preposterous claims respecting Charles D., one incident alone being the fact that he or his company borrowed some cuts of incandescent lamps from the Stanley people and republished them as the "Jenney Lamp, etc." The statement by Mr. Rorison in his communication to the effect that the Fort Wayne Company has represented Charles D. Jenney as the originator of its system in former publications is wholly untrue. No such statement was ever made in any document issued by this company.

There is a way for Mr. Rorison to get into business honestly and fairly. It is to make something that he has a right to make, and make it so good that people will buy it on its merits. In that field he will meet no law suits, no unfriendly criticism, no unfair competition from us. But he shall not steal our trade by false pretences if we can help it, and we think we can.

R. T. MCDONALD,
Treasurer Fort Wayne "Jenney" Electric Light Co.
FORT WAYNE, Ind.

Electricity in Warfare.*

BY LIEUTENANT B. A. FISKE, U. S. NAVY.

The first practical plan for using electricity in warfare was devised and executed by Col. Samuel Colt, the inventor of the revolver, who in 1841 wrote to President Tyler stating that he had invented an apparatus by means of which he could destroy in a moment the most powerful man-of-war, even though miles away, and asking that the government give him opportunity for demonstrating the truth of his statement.

The truth of his statement he demonstrated a year later by exploding a "torpedo" under water in New York harbor by means of electricity. Following up this success, he totally destroyed, by similar means, an old gun-boat named "Boxer," and six weeks later, in sight of the President, General Scott and others, he destroyed a schooner in the Potomac, distant five miles. Congress at once appropriated $17,000 to continue his experiments and perfect his apparatus; and in two months from this time he blew up the brig "Volta" in New York in the presence of fifty thousand spectators. All of these vessels were at anchor; but in the spring of 1843 Colonel Colt demonstrated the further value of his invention by blowing up a vessel while under way in the Potomac, he being at Alexandria, five miles distant.

These performances seemed in that day little short of magic, and their practical value was evident to many; yet they stopped short at this point, and were never resumed. Colonel Colt endeavored to get further assistance from the government, but without success. For a variety of reasons, the authorities regarded his plans with disfavor, and Colt, disheartened and distressed, was compelled to abandon his invention just at the time when its success was assured and its details imperfected.

But the Russians caught his ideas, and in the Crimean war we find the harbor of Sebastopol defended by torpedoes, many of which were operated by electricity. A few years later, in our Civil war, the electrical torpedo was extensively used by the Confederates in the protection of their harbors. In the Franco-Prussian war torpedoes were so successfully employed in the defense of harbors that hostile ships did not even attempt to enter them; and in the Russian war, the mere suspicion that a harbor was defended by torpedoes was enough, in many instances, to keep a hostile fleet at a surprising distance—for the hostile fleet could not know just how far beyond a harbor the torpedo defense extended.

Since the experiments of Col. Colt, the electrical torpedo has gradually improved, keeping pace with the progress of the sciences of electricity and engineering. Yet the original plan is the basis of the most elaborate and perfect instrument; and to Col. Colt we owe the surest defense we have for the cities and harbors of our extensive coast.

At the present day an electrical torpedo consists of a strong, water-tight vessel of iron or steel, which contains a large amount of explosive, usually gun-cotton, and a device for detonating this explosive by electricity; and the most important form is that form which is anchored in a channel, and which is made to explode when an enemy's ship passes near it. These torpedoes are usually called "submarine mines."

In our war most of these torpedoes were not operated by electricity but by mechanical means, which consisted for the most part of levers protruding outside the case, and so connected with the explosive inside, that when a lever was struck by a passing vessel a hammer inside was caused to fall upon a cap, just as when the trigger of a musket is pulled, a hammer is caused to fall upon the cap. These mechanical torpedoes were used with considerable success by the Confederates, and they caused tremendous damage to the Union ships; but they had a number of defects on account of which they have been almost entirely supplanted by the more complete, though much less simple, electrical torpedo.

One of the defects of mechanical torpedoes was the danger attending the operation of planting them, another was the danger attending the operation of raising them, another was the fact that it was impossible to tell whether they remained in order, save by the expensive and suicidal plan of seeing if they would explode; and still another defect was, that a mechanical mine did not know a friendly ship from a hostile one, but would sink either with absolute impartiality.

Now it is clear that an electrical torpedo is free from *all* these defects, because it cannot be exploded unless a current of electricity be sent through it from a battery on shore or on board ship; so that the only thing to do when it is desired to make it harmless, is simply to disconnect the battery; and when it is desired to put the mine into operation again, the only thing to do is simply to reconnect the battery; moreover, the condition of the mine can at any time be determined by sending a very minute current through it, even though the torpedo be miles away and buried in water many fathoms deep.

In order to understand how electricity can explode a torpedo, it is sufficient to know that when a current of electricity goes through a wire it heats it to some extent; and if the wire be small enough, the heat procured is sufficient to make the wire white hot. Clearly, if powder or fulminate of mercury be in contact with a white-hot wire, the powder or fulminate will be ignited, and if this powder or fulminate be inclosed in a tight vessel together with powder or gun cotton, a tremendous explosion will ensue. Therefore, in order to explode a torpedo, the only thing necessary is to send a current of electricity through a very small wire, preferably of platinum, which is within the torpedo and in contact with the explosive.

That part of a torpedo which includes this small wire and its connections is called the *fuse*. In practice the fuse is a separate thing and is screwed into the torpedo case, the wire from the battery coming in through the fuse through a water-tight gland; so that after the fuse has been screwed in, the torpedo as a whole is water-tight, and may be left under water for months without injury.

If the explosive charge is wet gun-cotton, as is now usually the case, the fuse contains fulminate of mercury, and is surrounded by a small charge of dry gun-cotton. The heat of the fuse wire explodes the fulminate, the explosion of the fulminate causes the instant explosion of the dry gun-cotton, and this in turn causes the explosion of the whole charge of wet gun-cotton in the torpedo.

But it is evidently not sufficient to be able to explode a torpedo; we must also know when to explode it; that is, we must know when the hostile ship is in such a position that she will be destroyed if the torpedo is exploded. Clearly we can know this, if we have a chart showing the exact position of each torpedo, and have also an arrangement by which we can know at any instant the bearing of a ship coming up the channel from two stations properly situated. If the ship comes into such a position that she is in the line of one of the torpedoes as seen from each station, she is clearly on the intersection of those lines and is therefore directly over that torpedo; and the only thing necessary is to touch the electric key controlling that torpedo, thus sending an electric current through its fuse, and causing its instant explosion. Another way is to have the telescopes at the two observing stations so fitted that when both point at any torpedo, the current is automatically sent through that torpedo. Therefore, if the observer at each station keeps his telescope bearing on an advancing ship, electricity will do the rest, and the ship will sink when she comes within the radius of destructive effect of any one of the torpedoes.

But what can be done at night or in a dense fog?

Evidently these systems will not answer then, because a ship cannot then be seen, and for this reason torpedoes now are frequently made absolutely automatic, so that whether the time be day or night, or the atmosphere clear or foggy, the mere fact of a ship's striking a torpedo is sufficient to insure her instant destruction.

This result is secured by the use of what is known to electricians as an automatic circuit-closer—that is a device, which, when subjected to certain conditions, automatically bridges over the distance between two points which were separated, thus allowing the current to pass between them. In submarine torpedoes it is usual to employ a small weight, which, when the torpedo is struck, is thrown by the force of the blow across two contact points, one of which points is in connection with the fuse, the other in connection with the battery, so that the current immediately runs over the bridge thus offered and through the fuse. In practice, these two contact points are connected by a wire even when the torpedo is not in the state of being struck; but this wire is of such great resistance that the current is too weak to heat the wire in the fuse. Yet when the weight above mentioned is thrown across the two contact points, the current runs across this bridge instead of through the resistance wire, and is then strong enough to heat the wire in the fuse and explode the torpedo. Now the advantage of having a wire of high resistance between the contact points instead of having no wire between them, is that the current which then passes through the fuse, though too weak to fire it, shows by its very existence to the men on shore that the circuit through the torpedo is all right.

But instead of having the increased current caused by striking the torpedo to fire the torpedo directly, a better way is to have it simply make a signal on shore, and at the same time throw in a firing battery. Then, when friendly vessels are to pass, the firing battery can be disconnected, and when the friendly ship bumps the torpedo the working of the signal shows not only that the circuit through the fuse is all right, but also that the circuit closer is all right, so that had the friendly ship been a hostile ship she would certainly have been destroyed.

The action of the torpedo, placed in a harbor and connected by a submarine cable to an electric battery on shore, is thus shown to be quite a simple thing. But it should not be gathered from this that the protection of a harbor is a simple thing, or one that could be accomplished in a few days on the outbreak of war. It should be remembered that each torpedo contains from 100 to 1,000 pounds of gun-cotton, that hundreds of torpedoes will have to be used, that the amount of gun-cotton required will be enormous, and that it will be wanted in a hurry, but that the operation of making gun-cotton cannot be hurried. It must be remembered that to make the torpedo cases required will consume much time; that the making of the fuses is a matter requiring the greatest possible care and calculation; that the operation of properly laying down these heavy and yet delicate torpedoes in deep water, even in the best possible weather, is an operation requiring great nautical and engineering skill and practice. Yet even after the best possible system of submarine mines has been laid down, it will be of no use, unless an enemy's boats can be kept from countermining, and unless the operating rooms be furnished with the best instruments and thoroughly protected against capture by fortifications, guns and ships. It is no uncommon thing to hear men of intelligence airily say, "Oh, in time of war, we can defend our harbors by torpedoes." I do not think I am exaggerating when I say it would take a year to put the torpedo defenses of our harbors into proper shape, even if Congress were to appropriate the money to-morrow.

And after that a corps of men would have to be formed and thoroughly trained in laying down and taking up torpedoes and cables, making splices in submarine cables, testing circuits, managing electric batteries, etc.

In order to detect the presence of torpedoes in an enemy's harbor, an instrument has been invented by Captain McEvoy called the "torpedo detector," in which the action is somewhat similar to that of the induction balance, the iron of a torpedo case having the effect of increasing the number of lines of force embraced by one of two opposing coils, so that the current induced in it overpowers that induced in the other, and a distinct sound is heard in a telephone receiver in circuit with them.

As yet this instrument has met with little practical success, but its principle being correct, we can say with considerable confidence that the reason of its non-success probably is that the coils and current used are both too small.

Besides these stationary torpedoes or mines anchored in harbors, there is another class called spar torpedoes, which are carried on spars protruding from ships or boats, and which consist for the most part of cases of steel holding about 30 pounds of gun-cotton and fitted with electric fuses, similar to those for exploding submarine mines. The torpedo on the end of the spar is connected by insulated wires with an electric battery in the boat or ship, and it is designed to be shoved under a hostile ship by a determined effort and exploded there. The current is sent through the fuse by pressing an electric key at the proper moment, or a simple automatic circuit-closer may be put inside the torpedo, so that when the torpedo strikes the ship, a break in the circuit is automatically bridged over in the torpedo, thus allowing the current to heat the platinum wire in the fuse and explode the torpedo.

(TO BE CONTINUED.)

* Lecture delivered before the Franklin Institute, Nov. 13, 1885.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
BOSTON, Nov. 16, 1885.

The Gold and Stock Telegraph Company have contracted to put fifty instruments in various offices in the city. The employés of the company have been busily at work during the past week putting in apparatus and wires, and before another week rolls by the new stock tickers will be rendering service. The rates of the Gold and Stock Telegraph Company have been reduced to $12 a month, being about one-half the price formerly charged.

The new Financial Telegram Company, concerning which mention has heretofore been made in this paper, is furnishing its new ticker in competition with the Gold and Stock Telegraph Company.

The question of having cheaper telephone rates in this city is now being agitated by the Mayor and the Fire Commissioners, and a conference has been had with the New England Telephone and Telegraph Company. The city is paying about $12,000 a year for telephone service without any privileges; while, on the other hand, the telephone company has, it is claimed, been constantly the recipient of favors and privileges from the city government, and, it is said, pays an exceedingly small sum in taxes. Mayor O'Brien, with an eye to the interest of his fellow-citizens, recently addressed letters to the mayors of other cities, asking for information regarding the telephone service, receiving in reply the following:

Albany pays $60. Baltimore, for ordinary service, $67; fire department, $30; water department, $100; general subscribers, $100. Brooklyn, general subscribers, $100; city, for ordinary service, $90; leased instruments, $20. Cincinnati, subscribers, $100; the city has the right to use the telephone poles. Chicago, subscribers, $125; city, $10, and 25 free telephones, and maintains hired lines, while telephone company maintains free lines. Cleveland subscribers, $72; city, $20 and 30 free telephones, and the right to use poles for city business. Detroit, city, one-half the usual rates. Lawrence, subscribers, $75; city, $36 and the rates not to be raised. Lowell, subscribers, $75; city, one-half the usual rates, except the fire and lamp departments, which pay $25. New York, subscribers and city, $150, with no privileges. New Haven, $60 and no privileges. Portland, subscribers, $75; city, one-half the usual rates, two fire telephones and the right to use poles for city business. Providence, subscribers, $60; city, one-half the usual rates and three free telephones. St. Louis, subscribers, $100; city, $100, the telephone company paying 2½ per cent. of gross receipts to the city until 1890, after that 5 per cent. Worcester, subscriptions, $75; city at special rates, connections free and use of poles for its wires. Boston pays $120 and has no privileges.

The Consolidated Electric Light Company, through their agent, Mr. P. H. Alexander, have received an order from the New England Telephone and Telegraph Company for a one hundred incandescent light (Sawyer-Man system) plant, to be installed in the magnificent headquarters of the latter company, on the corner of Pearl and Franklin streets, this city.

Mr. Charles Reitz, of Indianapolis, Ind., electrician and manufacturer of electrical apparatus, favored this office with a visit on Friday of last week. Mr. Reitz enjoys the reputation of being one of the most practical and scientific electricians in the country, and his advice and opinion are solicited by many.

The Shipman Engine Company, whose wonderful kerosene oil steam engine was exhaustively treated upon in THE ELECTRICAL WORLD of late date, have nearly finished their new factory, which will afford greatly enlarged facilities for the manufacture of this style of engine, for which the demand is so rapidly increasing. W. T. B.

PHILADELPHIA NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
PHILADELPHIA, Nov. 16, 1885.

The ordinance which says that all wires in the city of Philadelphia shall be placed under ground by January 1st next, bids fair to become a dead letter. The law was a hardship from the first, as THE ELECTRICAL WORLD showed two years ago, and the fact is now about dawning on the statesmen who pass laws ordering wires underground. Such a sweeping legal enactment reminds old operators of the pompous Canadian telegraph superintendent who, desiring to send a message and being told by the humble operator that the circuit was open, struck an appropriate attitude and exclaimed, "Tell them to close it, and sign my name." So, likewise, the statesmen order wires underground, without once reflecting that it cannot be done at once. In Philadelphia, so far from going underground, it is a remarkable fact that gangs of men are now seen daily stringing a new line of aerial wires on the stupendous masts that line the curb on Tenth street. This work is being done by the Western Union, and its efficiency is characteristic of the work always done in the Sixth district, under the supervision of Supt. W. B. Gill. The wires are of copper (No. 14) and on a bright sunshiny day, or when the electric light strikes them at night, they present a very pretty sight, reminding one of a harp with golden strings. The conductivity of such a line of wires will enable the operators to make their particular circuits "hum," as it used to be said when the very fastest work was done.

On Friday last we had some distinguished visitors from New York who came to investigate our underground system. Mr. William H. Johnstone, President of the Philadelphia Sectional Underground Conduit Company, acted as chaperone and afforded them the opportunity desired. He explained to them the intricacies, peculiarities and operation of the system, and in the evening entertained them at a dinner at the Bellevue Hotel. There were present from New York, Jacob Hess, Charles E. Loew, Thomas C. E. Ecclesine, John Thomson, J. Ensign Fuller, Daniel E. Hungerford, J. Fred. Dennis, W. R. Waring, and Ralph W. Pope. At the table were with them the following gentlemen of this city: William R. Balch, Joseph B. Ecclesine, Jr., Joseph C. Herr, Thomas J. Diehl, Carl Edelheim, George R. Thompson, George McGowan, William F. McCully and William H. Johnstone.

The underground system of the "Sectional" Company was thoroughly tested with electric light, telegraph and telephone wires in the conduit, and seemed to give satisfation to the distinguished visitors. The "test" was not as public as it might have been, as it was confined to the gentlemen named, and the visitors, who were in pursuit of knowledge, were measureably as free from any impertinent intrusion as exclusive dinners and closed carriages could make them. If they are not profoundly impressed with the "Sectional" system, they should at least be satisfied with the liberality of President Johnstone.

Last week the Electrical Committee of City Councils considered an ordinance authorizing the People's Telephone Company to erect their wires on and over the streets and roads of the city. A representative of the company stated that the company had no intention of running in opposition to any other similar corporation, but is intended to connect business establishments with residences. The matter was referred to a sub-committee for examination.

An ordinance granting permission to the American Telegraph and Telephone Company to lay underground pneumatic tubes, conduits, and cables under the streets of the city was also considered. Mr. Sargent, Superintendent of the Brooklyn Telephone Company, stated that the Company had laid an underground cable, starting from New York and through New Jersey to Camden, and are now waiting for an entrance to the city. If permission is granted, it is intended to stretch a cable across the river and lay their wires underground on Walnut street to Fourth, and thence to the offices of the Bell Telephone Company. When the work is completed, so says the new company, all persons in this city will be able to communicate by telephone with parties in New York. The ordinance was directed to be reported to Councils with a favorable recommendation.

Thus it may be seen that, while the new era of (underground) telegraphy, etc., has not yet arrived in Philadelphia, we are working in that direction, and while it may not be "sectional" it must be universal by and by.

E. F. I.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
CHICAGO, Nov. 14, 1885.

The local conduit company is endeavoring to so complete its system as to enable it to conveniently accommodate users of the electric light in each and every business block. To furnish the accommodations required, however, it is necessary to get into the block in some way or other with the wires, and this the company proposes to do by going under the sidewalk. The company's idea is also, in some cases, to run wires laterally under the sidewalk, never to exceed the length of a single block. In its endeavor, however, to solve the problem of getting from the conduit into the blocks in the way above indicated, the company is violently opposed by some portion of the local press. To an ordinary observer it would seem as though the company had chosen the best method to get from the conduit to the block, and that in proposing to adopt this plan it was only following the easiest and most practicable route from the street to the building. The company is accused, however, of wishing to encroach upon the rights of property owners, and to monopolize the space under the sidewalk. It is also claimed that the wires so placed will be dangerous to property and to workmen. In fact, all sorts of ridiculous objections are raised; at the same time no other practicable method of doing what it is absolutely necessary to do is brought forward by the objectors. The opposition is absolutely without reason. The only objection that could possibly have any bearing is that of danger, and everybody knows, who knows anything about the matter, that it is only necessary to properly place, insulate and maintain an electric light wire to make it as harmless as a twine string. The fact is that the company's plan of getting from the conduit into the blocks is the best that could possibly be proposed, and the company should be encouraged in its endeavor to make electric lights available for all, and consequently popular, rather than impede it with senseless objections put forward by unreasoning objectors.

A portion of the local press seems to have been giving up the week to electrical matters, as in addition to the conduit company, the telephone company has had to come in for its share of unintelligent criticism. The rate charged is the particular thing struck at, and one of the papers has gone to a good deal of trouble and expense to get together a lot of information which was already at hand and available in far better and more complete shape than the paper referred to was able to present it. The journal in question, however, seems to have found out some things that it did not know before, and, judging from some of its later expressions, the result of its investigation has been to make it understand that the matter of rates is regulated after all entirely by local circumstances, and that taking everything into consideration, the highest of them can hardly be called exorbitant. This same paper has been publishing long specials from Washington regarding the progress made before the government by the parties wishing to have the Bell patent annulled, and altogether we have been furnished during the past week with a good deal of electrical literature by the daily press. For this we are duly grateful, as the attacks have done no possible harm, serving rather only to stimulate the general interest in electrical matters, and consequently to increase the circulation of THE ELECTRICAL WORLD.

The Dorsett Underground Conduit System is, as our readers well know, attracting a good deal of attention of late. Some ten miles of the system are in use in Chicago, and it is said that it is being, or about to be, introduced in Milwaukee, St. Louis, Cincinnati, Minneapolis and St. Paul, with a good show for adoption by New York and other Eastern cities. The important fact to be kept in mind in regard to this conduit is, that it is first, last and all the time an insulator. Frost cannot affect it. It is a non-absorbent of moisture, and acids and alkalies are unable to harm it. Besides, the system is thoroughly worked out, has stood the test of time, and is in practical operation. It is giving every satisfaction in Chicago, and seems to be favorably looked upon wherever its introduction is proposed.

The gas people have been beaten at Muncie, Ind., and orders have been given for the poles, engines, dynamos, lamps and apparatus complete for a large electric light plant. Having been beaten in their attempt to *keep* the electric light company out, the gas company now proposes to *starve* them out, and threatens not only to put down the price of gas, but also to put in an opposition electric light plant. Judging from present indications, light will be plenty and cheap in Muncie.

The Wabash Electric Light and Power Company, of Wabash, Ind., has been incorporated.

An Indianapolis paper says that the case aginst Telephone Superintendant Hockett under the misdemeanor act, for violating the State law regulating the rentals of telephones, came before Judge Norton, and by agreement a finding was entered against defendant, by which he was fined $5 and costs in two cases, and this was followed by an appeal to the Supreme Court. The trial was purely mechanical, the record being made up from the testimony in the civil suits before Judge Taylor.

A new district telegraph company has been organized in Indianapolis to take the rights and privileges of the one started there some six months ago by Dayton (Ohio) parties. W. A. K.

THE TELEGRAPH.

T. M. B. A.—The annual meeting of this association convened at 4 P. M., November 18, in the Western Union Building, this city.

Color-Blind Operators.—Dr. Hedrick has been engaged by the Baltimore & Ohio Railroad to go over the entire lines of that company and examine all telegraph operators in the company's employ for color-blindness. All those who fail to pass the examination will be removed.

The Domestic Company, Newark.—At the annual meeting of the stockholders of the Domestic Telegraph and Telephone Company, Newark, N. J., on the 12th, the following directors were elected for the ensuing year: George W. Hubbell, Marcus L. Ward, Edward Weston, Thomas W. Dawson, Enos Runyon, Thomas T. Kinney, Jabez Fearey, J. H. Dawson, Jr., and F. T. Fearey.

A Point Lost.—In the quadruplex suit of the Western Union Telegraph Company against the Baltimore & Ohio Company for infringement of patent, a motion made by the Baltimore & Ohio Company in the United States Circuit Court on Nov. 12 to strike out disclaimers offered in evidence by the Western Union Company was denied by Judge Shipman. Had the motion prevailed it would have delayed the conclusion of the suit several months.

Common Sense.—Mr. George D. Roberts, of the Postal Telegraph Company, says that telegraph rates are so low that there is very little profit in the business. Telegraph companies are not organized for fun, but to make money. The same principles that have led railroads to adopt pooling arrangements for their mutual benefit are also applicable to the telegraph business. No doubt sooner or later some such arrangement will be made between the different companies.

A Postal Plant Sold.—The plant of the Postal Telegraph Company (including all its fixtures and all the wires under ground and overhead within the District of Columbia) was sold at auction in Washington on Nov. 5 by United States Marshal McMichael to satisfy a deed of trust. The only bidder was Mr. Hillyer, of the firm of Hillyer & Ralston, for B. C. Elliott, the plaintiff in the suit, who bought the property for $4,000. The judgment against the property was for $10,000. It is said the underground wires alone cost the company $20,000.

Want Their Lines Back.—The Board of Trade Telegraph Company filed a petition on Nov. 5 at Chicago in its suit against the Bankers and Merchants' Telegraph Company, setting out that in February, 1884, it leased its telegraph lines to the Bankers and Merchants' Company on certain conditions, among which was the payment of the interest on $50,000 of bonds of the lessor and the payment of $6,000 a year additional as rent. The Bankers and Merchants' Company has failed to pay the semi-annual installments of rent, etc., amounting to $5,250, which matured Oct. 1, 1885, on account of its insolvency. The Board of Trade Company, therefore, has elected to declare the lease determined, and asks to have the Receivers of the Bankers and Merchants' compelled to surrender to it the leased lines.

Underground Wires Argued For.—The new extension ladder which the fire department is now using is showing in a very clear manner what a nuisance it is to have telephone, telegraph and electric light wires strung in front of all the buildings and in all the streets. These wires are an intolerable hindrance to the work of firemen, and are dangerous besides being in the way. Their danger was well demonstrated at the fire last Saturday night, when the men operating the extension ladder received shocks which might have been serious, on account of the ladders coming in contact with two of the electric light wires. The fact that the wires are in the way of the firemen is but one of many arguments which can be reasonably urged against the present system of conducting electricity. The proper place for the wires is under ground, and now is just the time for Minneapolis to make the change.—*Minneapolis Tribune.*

A Telegraph Foreclosure Suit.—The Farmers' Loan and Trust Company has brought a suit in the Supreme Court against the Postal Telegraph Company, the Postal Telegraph and Cable Company and Mr. Albert B. Chandler, receiver of the last-named company, for the foreclosure of a mortgage given in November, 1882, to secure $10,000,000 of bonds of the Postal Telegraph Company. In 1883 all the rights and title of the Postal Telegraph Company in real estate, wire, patents and other property were conveyed to the Postal Telegraph and Cable Company, subject to the lien of a mortgage. The Postal Telegraph and Cable Company was in trouble at the same time, and in May last Messrs. Campbell C. Brown and Thomas Fleming obtained a judgment for $180,000 against the company, which was followed by the appointment of Mr. Chandler as its receiver. The suit was begun at the request, it is stated, of the holders of one-third of the $10,000,000 of bonds issued.

War of the Wires.—It is stated on excellent authority, says the New York *Daily Telegraph*, that the Western Union has already begun cutting rates. It does not do this under its own name, but under that of its annex, the Mutual Union, which has no general office except that of its devourer, and no local offices, except when it is necessary to show opposition to the Baltimore & Ohio. From Boston to Portland, Me., the rates have been reduced by this company to 10 cents for ten words; from Albany, Rochester and New York State cities to Western competitive points they have gone down to New York rates, which have always been lower than those of towns 200 or 300 miles nearer Chicago; and from Lancaster, York and Harrisburg, Pa., to New York, Philadelphia and Baltimore, 10 cents. Nothing seems to be required to make a Mutual Union office out of one of the Western Union except to hang out a sign, and it is a singular and interesting fact that there are no Mutual Union offices in places in which the Baltimore & Ohio Telegraph Company has not effected a lodgment. Larger towns in their immediate vicinity are without both if without one.

THE TELEPHONE.

Long-Distance Lecturing.—At a recent lecture in Greenock by Mr. W. L. Carpenter, on the telephone, transmitters were placed on the lecture table, and through their instrumentality nearly the whole of the lecture was heard by a party of ladies in a Glasgow newspaper office, twenty-five miles away.

Absconded.—George J. Fryer, express and telephone agent and postmaster at Glencoe, Ont., has absconded, taking with him between $6,000 and $7,000 left with him by banks to be expressed. The Brooklyn telephone exchange has been similarly treated by a collector, but is understood to be secured by bondsmen of the late departed.

New York and Philadelphia.—The Electrical Committee of Councils, Philadelphia, has agreed to report favorably an ordinance granting permission to the American Telegraph a d Telephone Company to lay underground pneumatic tubes, conduits and cables in the city. The company has laid a cable from New York to Camden, and intends continuing it across the river, up Walnut street to Fourth, and thence to the offices of the Bell Telephone Company, at Fourth and Chestnut. By this arrangement it is intended to afford the public direct telephonic communication with New York.

Rocks Ahead.—Opponents of the Bell Company are very confident, says the Boston *Herald*, that Secretary Lamar will approve a suit to test the principal Bell patent. With a concentrated legal attack upon its patents and with a popular clamor against advanced charges for telephone service, the American Bell Company is having rather a stormy time of it. The legal opposition will inevitably continue so long as lawyers can find a loophole for attack. Popular opposition can be reduced by a concession in royalties. If no concession is made, a legislative attack all along the line is a probability.

Analyzing Figures.—The Lowell *Mail* has come upon a report of Erie subscribers of Oct. 1, 1885, and finds a total in all divisions and agencies of 8,588, against 9,167 May 1, 1885, a loss of 579 in 17 months. The *Mail* comments as follows: "With the above figures before our readers, many possible holders of the stock of this corporation, we surmise that the first inquiry will be this: What is the reason of this wholesale loss of subscribers, as is the case at Brainard, Minn., Huron, D. T., and other places shown on the list, which appear entirely wiped out of existence? This is a question some one on the inside must answer. The somewhat startling fact in relation to New England affairs is reported, to wit: That there are some 500 sets of instruments charged to the New England company by the American Bell company, more than can be accounted for, *i. e.*, the Bell Company are collecting royalties on 500 more sets of instruments than the New England company are receiving rental for. It cannot be denied that the instruments have been shipped; but where are they? Where was Moses when the light went out? Is it not possible that this same manner of leakage has crept into Erie affairs at some period of its existence?"

The Value of Erie.—It must not be supposed, remarks the Boston *Commercial Bulletin*, that all sub-telephone stocks are staggering in the same slough of despond as the New England Telephone Company. The sub-telephone companies of New York, Philadelphia, Chicago, San Francisco, Rhode Island, and many other places, are regular dividend-payers. Erie, which was depressed by bad management, is now creeping up to the society of the better class of sub-companies, like those named. It earned $13,689.39 above all expenses last month, and can at least maintain that, or a trifle over $40,000 per quarter. Only $24,000 is required to pay the present quarterly dividend of ½ of 1 per cent., leaving a surplus of $16,000 to be applied to the extinction of the floating debt. The floating debt is now $60,000, and when it is extinguished, the present earnings of $40,000 per quarter will easily pay 8 per cent. per annum in dividends and permit the accumulation of a surplus. Three per cent. per annum on 27½ is equivalent to 11 per cent. And the earnings will increase The territory of the Erie Company—Cleveland, O., Minneapolis and St. Paul, and the whole State of Texas—is among the most thriving and progressive in the United States.

THE ELECTRIC LIGHT.

Halifax, N. S.—The press and people are very much pleased with the Thomson-Houston plant just installed and started up by the Royal Company of Montreal. By last reports, the management has seventy lights running.

Electric Lighting in Munich.—Electric lighting is said to have made greater advances in Munich than in any other town in Germany. There are upwards of 30 installations in the town, of greater or less extent, the total number of lamps in use being 133 arc and 3,770 incandescent.

Plattsburgh, N. Y.—Dark streets will soon be a thing of the past in Plattsburgh. Mr. D. S. Hyman, the representative of the Excelsior Electric Light Company, of New York, has completed arrangements with the Saranac Horse Nail Company to furnish the power to generate the electricity with which the company propose to light the town. The board of trustees having granted the necessary permission, the work of erecting the poles and stringing the wires will be commenced at once, and in the course of thirty days the company expect to have things in working order.

The Electric Light in Sweden.—Owing to the great height of water lately in Ljusne River, floating has temporarily been suspended in the lower river, and picking out the logs to be drawn on land for winter sawing at Ljusne saw-mill could not, in consequence, be proceeded with, for which reason now, to make up for lost time, having first tried torches to get sufficient light at the timber booms, the electric light has been carried from the saw-mill, and been found especially suitable, as it not only considerably lightens the labor, but also enables it to be done with greater safety.

On the Great Forth Bridge.—The electric plant employed in lighting the great Forth Bridge Works consists of 13 dynamo machines, 100 large arc lamps of 2,000 candles each, 500 incandescent lamps of 200 candles each, and about 12 miles of mains. Among the many interesting operations which have occurred is the lighting of the deep water caissons for the main piers, in some cases from 70 ft. to 80 ft. under water. Those at South Queensberry have been lit by incandescent lights, while at Inchgarvie, owing to blasting operations being necessary, arc lamps have been employed. The firing of the blasting charges has also been performed from the same dynamo which feeds the light.

Litigation in Pittsburgh.—The Brush Electric Light Company and John E. Ridall have filed a bill in equity against the Allegheny County Light Company. The plaintiffs say that in 1881 defendant company and plaintiffs entered into a contract whereby the defendant was guaranteed the exclusive right in the cities of Pittsburgh and Allegheny of leasing or furnishing for the use of others, lights—such as the apparatus made by plaintiff is designed to give—and so far as necessary for such purpose to put up lamps with all accessories, with no right in defendant to make or construct any of the apparatus, etc. The Court is asked to declare this contract binding and in force, and that the defendants be enjoined from constructing or making commutator apparatus, machinery or accessories or any part thereof which plaintiffs furnish, and that the defendant be restrained from using any other electric arc light apparatus or carbons except those provided by plaintiff.

APPLICATIONS OF POWER.

A Telpher Line for Trinidad.—It has been proposed to lay down a telpher line in the island of Trinidad, West Indies, to bring produce to the coast. The conveyance at present, by mule back, costs about $2 a ton.

Opinions of Street-Car Men.—The fourth annual convention of the American Street Railway Association has just been held in St. Louis. The committee on "Progress of Electricity as a Motive Power" made a report to the following effect: "Your committee considers the application of electricity in the propulsion of street cars as entirely feasible. The seven electric railways in Europe, besides the tests in this country, prove this to be true. It is now narrowed down simply to a question of dollars and cents, or comparative economy with horses, cable power, etc. In the crowded streets of American cities no system of overhead wires would be permitted by the municipal authorities. The rails could not be used to carry the currents, for obvious reasons; therefore, a conduit system offers the only practical solution. The system of running cars by accumulators can be applied with least trouble and less first cost, but at a great sacrifice of electricity. The result of two years' working of the electric railway at Zankerode, Prussia, showed that only 30 per cent. of the power of the steam engine was applicable to the propulsion of cars, but even this compares favorably with the cable system." In conclusion, a letter was read from a New York firm offering to equip any tramway with electric motors, and to stipulate that should satisfaction not be given the parties contracting, to remove the same at the company's own cost.

PERSONALS.

Dr. J. C. Clark has been appointed medical examiner for the Telegraphers' Mutual Benefit Association in New York.

Mr. D. P. Livermore, of Hallowell, Me., now in his eighty-first year, has been the local telegraph operator since 1850, and the old gentlemen is still at it.

Leo Daft.—One of our exchanges says: "Leo Daft, of the Daft motor, is 43 years old, an Englishman, and he was educated as a mechanical engineer at the London University. His father was a member of the Institute of Civil Engineers." To which may be added the information that he has been so long in this country as to make him a very good American. He has thin, well-cut, refined features, wears habitually a thoughtful expression, and is a well-informed man, whose conversation on a variety of topics, as well as upon electricity, is worth listening to.

Mr. Fred H. Angell.—The many friends of this popular gentleman will be interested to learn that he has severed his connection with the American Electrical Works, of Providence, and has made an engagement with the Detroit Electrical Works. We understand that it is Mr. Angell's intention to open an Eastern Agency in this city for the latter concern, where he will carry a full line of its many excellent productions. Mr. Angell will soon be ready to call on the trade, and expects, by a careful attention to the wishes of his friends and customers, as well as by offering the best goods at the closest prices, to enjoy a large share of their orders. He starts out with every prospect of success.

Col. R. C. Clowry.—Public attention is newly directed to Col. R. C. Clowry, General Superintendent of the Western Union Telegraph Company, by his election as Vice-President and Director of the company. His successful career, the eminence he has gained, all achieved by force of his own endeavors and his own merits is a good thing for American boys to consider, especially as he has carried constantly with him a good name and an honest record. Thirty-five years ago, when a small boy, he sat on a high stool manipulating the keys. Col. Clowry has been successively promoted to his present high position, and during the war he had charge of the military telegraph lines of the Southwest, with the rank of colonel. He has always been identified with the Western service of the Western Union Telegraph Company, and his last promotion will be of great benefit to the West.—*Des Moines (Ia.) Register.*

BUSINESS NOTICES.

The Davis Cut-Out, manufactured by the Electrical Development Company, of Boston, answers all the requirements of a perfect apparatus. It is "double pointed," thus insuring an absolute break, and from its very nature a slow break or make is impossible.

Phonography and Type-Writing.—There is a brisk demand at all times for good stenographers and typewriters, and when there is added skill in telegraphy to their other acquirements, their services are highly paid. Messrs. Close & Black, 1338 Chestnut street, Philadelphia, give lessons directly or by mail in phonography and typewriting, and undertake to carry their pupils through very rapidly. A pamphlet giving full particulars can be obtained from them, free, on application.

Anti-Magnetic Shields for Watches.—These shields, made by Giles, Brother & Co., State and Washington streets, Chicago, are an efficient protection to the works of watches from magnetism, as many testimonials in their possession show. This firm also demagnetize watches that are already affected. The Eastern Agent is W. A. Wales, 16 Maiden lane, New York.

Card from the United States Electric Lighting Company.—Special attention is called to the foot-note of the Edison Company's advertisement, which has been running since August 15 in this paper, in which they give us a gratuitous notice in their conspicuous attempt to mislead the public. The Chicago *Times* of August 9 read as follows: "The last statement issued by the United States Electric Lighting Company develops the fact that during the past year over **53,100** incandescent lights were installed or contracted for by that company, instead of 3,100, as stated in yesterday's *Times*." The Edison Company seem to be clutching at treacherous straws.

A Handsome Catalogue.—We have received from the American Electric Manufacturing Company its handsome and instructive pamphlet, illustrated, on the American arc system of lighting. We have lately taken occasion to illustrate and describe the very efficient system owned by the company, and need only here remark that *all* its many admirable points in principle and application are here fully treated. On the front inside cover, Mr. E. H. Goff, President, makes a forcible appeal to the agents and representatives of the company to do their work in the best possible manner, and to present the system in the best possible way. On the inside page of back cover a good word is said in behalf of the electrical press, recommending all interested in electricity to study the literature and journalism of their business.

Glenn's Sulphur Soap
Heals and beautifies, removes pimples and blemishes; 25c.
GERMAN CORN REMOVER kills corns and bunions; 25c.
HILL'S HAIR AND WHISKER DYE, black and brown; 50c.
PIKE'S TOOTHACHE DROPS will cure in one minute; 25c.
DEAN'S RHEUMATIC PILLS are a prompt, sure cure; 50c.
HALE'S HONEY, the great cough cure, 25c., 50c. and $1.

STOCK QUOTATIONS.

Telegraph, telephone and electric light quotations on the New York Stock Exchange, Boston Exchange and elsewhere are as follows:

Telegraph.—Am. Dist., a 29; Am. Cable, b 67¼, a 68¾; B. & M., b 4, a 4½; Western Union, b 78¼, a 79.

Telephone.—Am. Bell, b 174, a 175; Erie, b 27¼, a 27½; Mexican, b 1 1/16; New England, b 25, a 26.

Electric Light.—No new quotations.

MISCELLANEOUS NOTES.

Electro-Static Voltmeter.—We omitted to mention in a recent issue that the electro-static voltmeter of Sir Wm. Thomson, therein described, is in the possession of the Electrical Supply Company of this city, who have recently imported it.

Another Conduit Company.—The Wheaton Sub-Electric Conduit Company has been incorporated for the purpose of laying wires under ground. The corporators are John A. Belvin, Samuel Conover, Charles A. Post, John J. Kiernan, John A. Todd, Stephen T. Willett and Henry A. Heiser. The capital is $1,500,000.

Insulators.—An ingenious form of insulating stem for experiments in static electricity has been devised by M. Fonvielle. He uses a hollow rod of glass and inserts a spiral of platinum wire, which, being rendered incandescent by means of a small bichromate battery, heats the stem and keeps it dry, thus insuring perfect insulation.

Refining Sugar by Electricity.—A number of St. Petersburg capitalists have combined for the formation of a joint-stock company for refining sugar by the American Friend electrical process. It is said to be beyond doubt that the process will considerably reduce the cost of Russian refined sugar. It is proposed to erect mills for the purpose in St. Petersburg, Moscow, Odessa and Kieff.

Caught in the Act.—W. J. Higgins is employed by the Boston Electric Protective Association. While on duty recently the apparatus summoned him to the building 7 and 9 Court street. He noticed a young man about nineteen years old attempting to effect an entrance into the furnishing store of Briggs & Cushman by means of a bulkhead. Hastily notifying Patrolman Sommer, of the second police, who was passing, he assisted that officer in taking the surprised young man into custody. The latter was conducted to the Court Square station.

Sugar Made by Electricity.—The synthesis of saccharose having been accomplished by Messrs. Aubert and Giraud, it is anticipated, says a contemporary, that the discovery may prove most important to the sugar industry. Amylaceous matter obtained from the potato, having been converted into glucose in the usual manner, is submitted to the action of an electric current equal to about seventy-five volts. The electrodes were immersed in the solution, and the current reversed from time to time. In about two hours the reaction terminated, as indicated by the liquid no longer giving the characteristic color with tincture of iodine or a precipitate with alcohol. The liquid was then defecated with lime, which was subsequently removed by carbonic anhydride, and the syrup was decolorized and crystallized. On analysis it yielded 88.38 per cent. of saccharose, but was far from being cane sugar. It is questionable whether the reaction consists in the dehydration of glucose, the union of a molecule of dextrine with one of glucose, or the hydration of dextrine.

Zinc Manganese Battery.—In some experiments with Leclanché batteries, Dr. Emil Boettcher used for the negative element plates consisting of 40 per cent. of retort carbon, 55 per cent. of manganese and 5 per cent. of binding medium, the whole being combined under a hydraulic pressure of 200 atmospheres. The dimensions of the plates were 12 centimeters long, 4.2 centimeters wide and 2 centimeters thick. The electromotive force of a cell composed of such a plate and an amalgamated zinc rod in a

solution of sal ammoniac was 1.56 volt. From a calculation of the quantity of heat generated and absorbed by chemical action in a battery of this kind, Dr. Boettcher concluded that sulphuric acid would give a better result than the solution of ammonic chloride, provided a counter electromotive force was not set up in consequence of the formation of manganous sulphate and liberation of oxygen; but no such opposing force was manifested, although manganous oxide was dissolved. The electromotive force was 2.2 volts, or almost 50 per cent. higher than that of a Leclanché battery, in which a solution of sal ammoniac forms the exciting liquid. After remaining on short circuit for six hours, the cell gave 2 1 volts, and at the end of seventy-six hours the electromotive force was rather more than 1 volt.

Fitzgerald's Secondary Battery.—Under the recent patents of the inventor very considerable progress is said to have been made with these batteries, more especially in the ratio of weight to work. This result is obtained to a very large extent by making the negative elements entirely of peroxide in the form of hard slabs, electrical contact with the terminals of the battery being effected by means of strips of inoxidizable material. Thus the bulk of the element consists of the material to be acted upon, and the action moreover takes place throughout the whole of the mass, and it is not necessary to have a considerable weight of lead in order to support and make contact with the active material. By using inoxidizable contacts also, all chance of local action and the resulting "sulphating" is done away with. Sixteen ampère hours are obtained from every pound weight of these elements. The positive element has most remarkabe mechanical as well as electrical properties. It can be bent, or even rolled and unrolled, without damage, as it consists almost entirely of a peculiar form of spongy lead. As many as 27 ampère hours are obtained per pound of these elements. Recent tests made with a one horse-power cell which has been sent to Paris are said to have given a ratio of 10 ampère hours, or 20 watt hours per pound of plates, the total weight of the cell, including everything, being 75 lbs. Sulphate of magnesia has been discovered to possess wonderful properties as an electrolyte, its power of fixing peroxide in the "forming" process being greatly superior to the ordinary acid electrolyte. Thus the first cost of the batteries has also been greatly reduced.

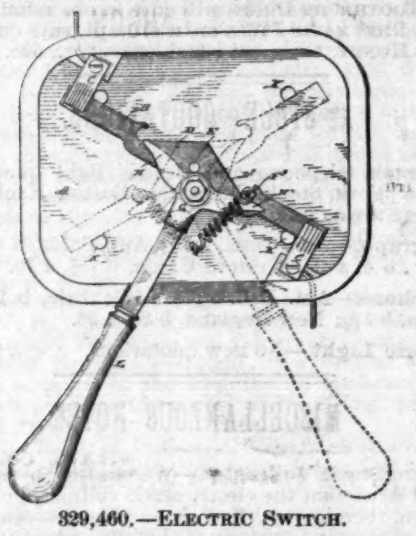
OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

PATENTS DATED NOVEMBER 3, 1885.

Electric Switch; Hermann Lemp, Hartford, Conn., Assignor to the Schuyler Electric Light Co., of same place..... (1), 329,460; (2), 329,461

(1) Consists in the combination, with the moving portion of the switch by whose movements the changes of connection are effected, of an actuator of any desired form, but preferably of the form or construction shown in the cut, arranged to engage with two oppositely-inclined cams or surfaces connected with or applied to the moving portion of the switch, and a lifting device, whereby the actuator may be brought from engagement with the bottom of either incline to engagement with the top of the other incline, where it may, by engagement with the cam or incline, throw the switch quickly into a position the reverse of that which said switch occupied before the operation.

(2) Consists of a carbon-carrier, a wheel-work mounted



329,460.—ELECTRIC SWITCH.

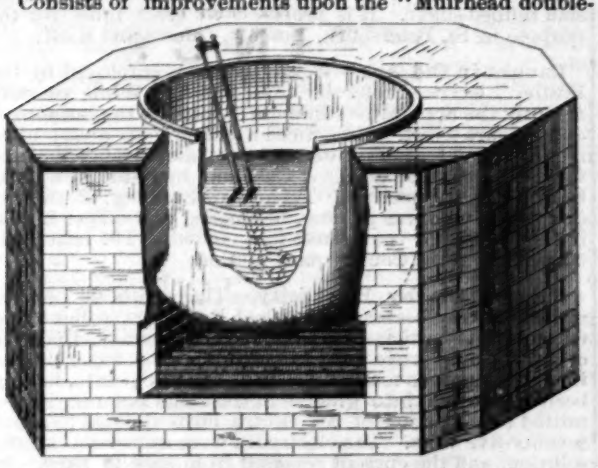
on a pivoted frame or lever, a brake-wheel gearing with the wheel-work and also mounted on said frame or lever, a pivoted brake-lever supported from the frame and normally engaging with the brake-wheel, and a fixed stop for acting upon the brake-lever.

Fire Alarm; Morris Martin, Malden, and John C. Wilson, Boston, Mass..... 329,468

Consists of a series of visual indicating signal-instruments, each of which, when operated, shows that a change has been made in an electric circuit extending from said instruments to a locality corresponding to the said instrument, and a multiple-signal-transmitting apparatus, and means governed by the indicating-instruments controlling the operation of the said transmitting apparatus, which is caused to transmit or produce a different audible signal for each visual instrument corresponding to the indication of the said instrument.

Submarine Duplex Telegraphs; Alexander Muirhead, Upper Norwood, England..... 329,477

Consists of improvements upon the "Muirhead double-



329,670.—PROCESS OF OBTAINING CARBON FOR INCANDESCENTS.

block system," as described in Letters Patent of the United States, No. 234,490, granted on the 16th day of November 1880.

Electric Railway Signal; Henry C. Nicholson, Mount Washington, Ohio..... 329,478

Consists of the main circuit which contains the relays for causing the operation of the signals, and of two normally-open shunt-wires, one of which when closed operates exclusively to display the danger signals, while the other when closed operates exclusively to display the safety signals.

Printing Telegraph; Samuel B. Van Nortwick, New York, N. Y..... 329,515

The type wheel of the instrument is rigidly mounted upon a shaft, which is impelled by means of a constant force, and which is permitted to advance step by step by a regulating pendulum escapement. At a given point in its revolution the type wheel shaft is designed to be arrested by means of a detent extending into the path of an arm moving with the shaft, provided an electric current is not at that moment transmitted over the main line and through the coils of an electro-magnet designed to move the detent from the path of the stop.

Incandescent Lamp; Charles H. Benton, Cleveland, Ohio..... 329,618

Consists of a hollow wooden part and of binding-posts secured thereto on the inside, so that the terminals are concealed, and having as a means of attachment screws with the heads abutting against the wood on the outside, and the screw ends engaging threaded holes in the respective binding posts.

System of Electrical Distribution; Harry M. Byllesby, New York, N. Y..... 329,621

The generators are provided each with a regulating-resistance c. Switches and safety-catches are provided for conductors $p\ c'\ n$. The feeding circuits also consist each of three conductors $p'\ c^2\ n'$, and these are connected to the lighting conductors $p^2\ c^2\ n^2$. The feeding conductors have switches and safety catches, and an additional adjustable resistance g is placed in the compensating conductor, to be used if one main conductor is thrown off, so that the compensating conductor forms one side of the circuit.

Telephone Call-Register; Angus S. Hibbard..... 329,646

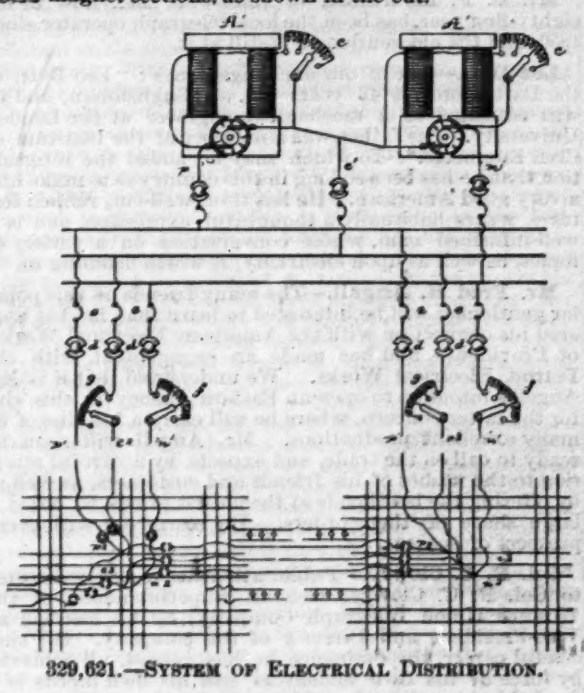
Consists of a call-register arranged in connection with the annunciator drop, and operated by the movement thereof.

Incandescents; Stephen Nicholson and Herbert A. Bowen, Providence, R. I..... 329,670

In a manner shown in the cut, the filament to be carbonized is inclosed in a form and plunged into melted metal, which is gradually raised to a very high temperature.

Regulator for Dynamo-electric Machines; William M. Schlesinger, Philadelphia, Pa..... 329,681

Consists of a dynamo-electric machine having its field-magnets wound in sections, in combination with a single controlling circuit-reverser connected with the ends of the field-magnet sections, as shown in the cut.



329,621.—SYSTEM OF ELECTRICAL DISTRIBUTION.

Siphon Recording Instrument for Cables; William Dickerson, Heart's Content, Newfoundland..... 329,723

Consists in the application to the ink duct or siphon of mechanism for imparting thereto a continuous mechanical vibration, and to thus insure a uniform delivery of the ink without permitting the pen to touch the paper.

Electric Earth Battery; George F. Dieckmann, New York, N. Y., Assignor of one-quarter to Paul Gmelin, of same place..... 329,724

Consists in arranging the electrodes in such a way that the resistance between the electrodes of each couple is small, while the resistance between the couples is relatively large, and connecting the negative electrode of each with the positive electrode of the next by a low-resistance conductor, so that the short-circuiting effect of the couples upon each other may be indefinitely reduced, and the effect is practically the same as if the couple were immersed in separated electrolytes.

Telephone; James Godfrey, Pittsburgh, Pa..... 329,732

The invention relates to the concentrator, which consists of a double cone.

Quadruplex Telegraphs; Joseph W. Larish, Buffalo, N. Y., Assignor to the Baltimore & Ohio Telegraph Co., Baltimore, Md..... 329,748

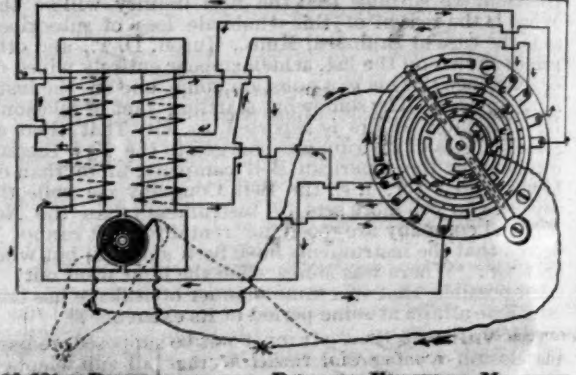
In the main-line circuit there are two relays responding to different classes of currents. The armature levers of the relays are organized to variously shunt different portions of the local circuit, in which there are included the coils of the receiving instruments. It is by shunting such portions that the receiving instruments are caused to respond. Each instrument is constructed with two opposing coils, the one of which is included at all times in the local circuit, while the other is included in a portion which may be shunted by the armature lever of the corresponding relay.

Electro-Magnet; Samuel Hickling Parkes, Birmingham, England..... 329,768

Consists of a steel wire bent in opposite directions into a series of parallel or slightly divergent sections, all the adjacent curves or angles of one edge of the series being of one polarity, and all the curves or angles of the other edge of the series being of the opposite polarity.

Induction Coil; Thomas J. Perrin, New York, N. Y., Assignor to the National Improved Telephone Co., New Orleans, La..... 329,772

Consists of independent primary wires wound on spools placed side by side upon the core, and secondary wires wound from end to end of the core over the primary coils.



329,681.—REGULATOR FOR DYNAMO ELECTRIC MACHINES.

Electro-Magnet Armature; Josef Steiner, Brooklyn, N. Y..... 329,782

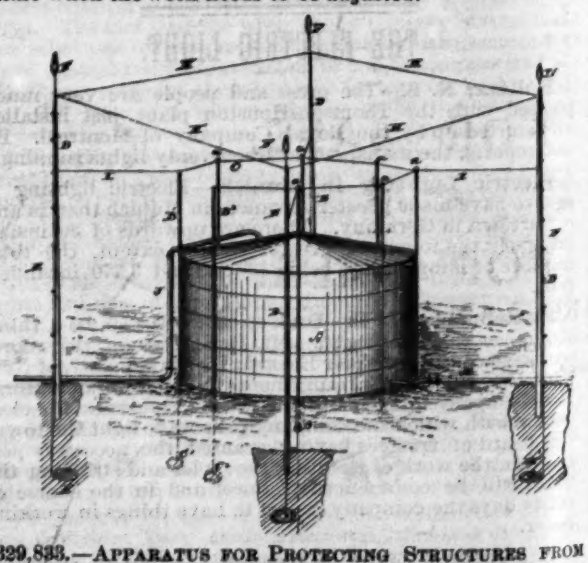
The object is to contract the dimensions without interfering with the efficiency. The armature is supported by a spring and is parallel to the length of the magnet.

Electric Circuit Breaker; Christopher L. Bruns, Bergen Point, N. J..... 329,808

Consists of a rocker and contacts, whereby the electric continuity of the circuit is established or interrupted, and electro-magnets on opposite sides of said rocker, reversely arranged levers, each carrying at one end an armature for one of said magnets, and having a hook at the other end, and toes or cams on the rocker, with which the hooked ends of the armature-levers engage.

Electric Signal; Milton W. Grovensteen, New York, N. Y..... 329,830

It is applied to lathes, planers, etc., to give notice of the time when the work needs to be adjusted.



329,833.—APPARATUS FOR PROTECTING STRUCTURES FROM LIGHTNING.

Apparatus for Protecting Structures from Lightning; Charles J. Hubbell, Washington, D. C..... 329,833

He claims a system for protecting receivers of inflammable or explosive substances from atmospheric electricity, comprising a cordon of poles extended above such receiver, and provided with a circuit-cable supported upon the upper ends of said poles and in metallic contact with the receiver, and having its ends terminating in coils in the subterranean sheet, combined with a distant cordon of cables of a higher altitude, as shown in the cut.

Telegraph Call-Box; Frank B. Wood, New York, N. Y., Assignor to the New Haven Clock Company..... 329,871

Consists in an ar angement whereby the pusher-rod, when once it has started the signaling mechanism, cannot be moved to arrest the motion thereof, or in any wise to interfere with the same.